System Multimeter

PM2534
PM2535

Service Manual

4822 872 35302
860516

I&E

Industrial & Electro-acoustic Systems Division

PHILIPS

Industrial &
Electro-acoustic Systems

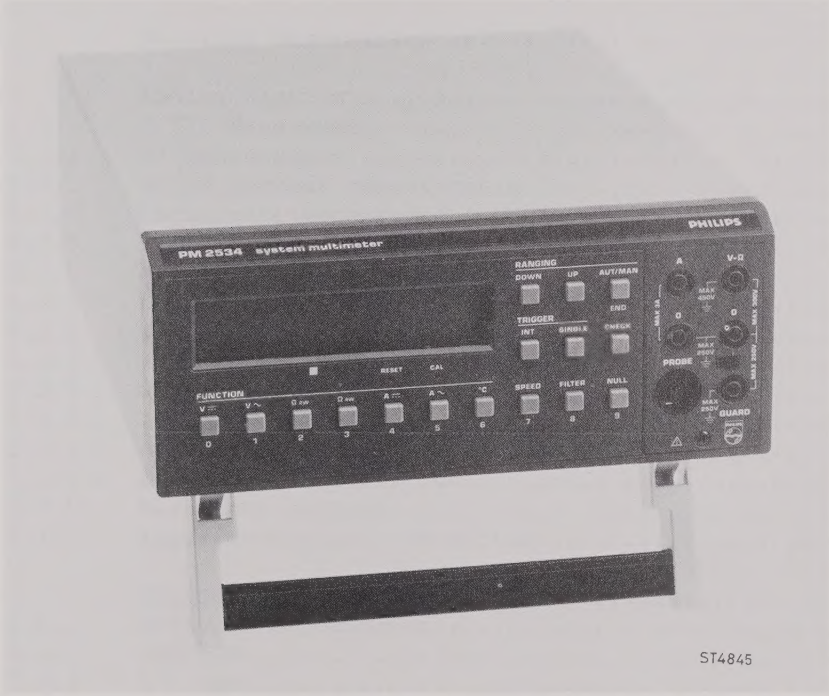
PHILIPS

System Multimeter

PM2534
PM2535

Service Manual

4822 872 35302
860516



PHILIPS

PHILIPS

IMPORTANT

In correspondence concerning this system, please quote the type number and serial number of the units as given on the type plate.

NOTE: The design of this system is subject to continuous development and improvement. Consequently, this system may incorporate minor changes in detail from the information contained in this manual.

© N.V. PHILIPS GLOEILAMPENFABRIEKEN-EINDHOVEN-THE NETHERLANDS 1986

PRINTED IN THE NETHERLANDS

CONTENTS PAGE

1. SAFETY INSTRUCTIONS 1-1

1.1 General clauses 1-1

2. CHARACTERISTICS 2-1

3. CIRCUIT DESCRIPTION 3-1

3.1 Explanation of the block diagram 3-1

3.2 Detailed description 3-6

3.3 Analog section 3-6
3.3.1 V ⎓ Measurement 3-7
3.3.2 V~ Measurement 3-9
3.3.3 DC/AC current measurements 3-11
3.3.4 Resistance measurement 3-11
3.3.5 Temperature measurement 3-12
3.3.6 Multiplexer 3-12
3.3.7 Control of analog section 3-12
3.3.8 Guard circuit 3-12
3.3.9 Analog to Digital conversion 3-13
3.3.9.1 General 3-13
3.3.9.2 ADC principle 3-13
3.3.9.3 Automatic zero 3-14
3.3.9.4 DAC 3-14
3.3.10 Reference voltages 3-14
3.3.11 Inguard-outguard connection 3-15

3.4 Digital section 3-15
3.4.1 Software description 3-15
3.4.2 RAM/ROM 3-16
3.4.3 I^2C bus 3-16

3.5 IEEE/IEC interface 3-17
3.5.1 Receiving 3-17
3.5.2 Transmitting 3-17

3.6 Display/keyboard 3-18

3.7 Data of components 3-18
3.7.1 8031 AH microcomputer 3-18
3.7.2 MAF 8441 3-22
3.7.3 DAC 08 E 3-24
3.7.4 TL 7705A 3-25
3.7.5 OM 503 3-26
3.7.6 SA 1045 3-27
3.7.7 OQ 0300..... 3-28
3.7.8 OQ 0301 3-29
3.7.9 SA 1300 3-31
3.7.10 PCF 8574 3-31
3.7.11 OQ 0068 3-33
3.7.12 LTC 1052 3-34

4. DISMANTLING THE INSTRUMENT 4-1

4.1 Removing the cover 4-1

4.2 Removing the top screening 4-2

4.3 Removing the bottom screening 4-2

4.4 Removing the front assembly 4-2

5. CHECKING AND ADJUSTING 5-1

5.1 General information 5-1

5.2 Calibration 5-2

5.3 Adjusting the PM2534/PM2535 with the aid of a controller 5-9

6. CORRECTIVE MAINTENANCE 6-1

6.1 Special parts 6-1

6.2 Replacing parts 6-2
6.2.1 Parts on the PCB 6-2
6.2.2 LX-display, window and interconnection rubber 6-2
6.2.3 Input unit 6-3
6.2.4 Interchanging input unit 6-4
6.2.5 Fuses 6-4

6.3 Trouble shooting 6-5

7. SAFETY INSPECTION AND TESTS AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT 7-1

7.1 General directives 7-1

7.2 Safety components 7-1

7.3 Checking the protective earth connection 7-1

7.4 Adaption to the local mains 7-2

7.5 Adaption to the local mains frequency 7-2

8. PARTS LIST 8-1

8.1 Mechanical parts 8-1

8.2 Electrical parts 8-3

9. CIRCUIT DIAGRAMS AND PRINTED CIRCUIT BOARDS LAY-OUTS 9-1

10. GLOSSARY OF TERMS 10-1

1. SAFETY INSTRUCTIONS

Read this page carefully before installation and use of the instrument.

The following clauses contain information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.
Adjustment, maintenance and repair of the instrument shall be carried out only by qualified personnel.

1.1 GENERAL CLAUSES

1.1.1 WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to life.

1.1.2 The instrument shall be disconnected from all voltage sources before it is opened.

1.1.3 Bear in mind that capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

1.1.4 WARNING: Any interruption of the protective earth conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

1.1.5 Components that are important for the safety of the instrument may only be renewed by components obtained through your local Philips organisation.

1.1.6 After repair and maintenance in the primary circuit, safety inspection and tests, as mentioned in Section 7 must be performed.

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_07619

2. CHARACTERISTICS

For the characteristics of the PM2534 and PM2535 refer to Chapter 2 of the operating manuals for these instruments.

3. CIRCUIT DESCRIPTION

3.1. EXPLANATION OF THE BLOCK DIAGRAM (refer to figure 3.2)

The PM2534 can be subdivided into three parts.

1. Analog part
2. Digital part
3. Display-keyboard part

In the analog section all signals to be measured are converted into DC voltages. These DC voltages are attenuated by a DC attenuator or amplified by a DC amplifier.
AC voltages are attenuated by an AC attenuator or amplified by an AC amplifier. The signal is converted into a DC voltage and applied to a multiplexer.
For AC/DC current measurements two shunts are used, one for 30 mA and one for 3A measurement.
For resistance measurements the PM2534 uses a programmable current source.
For ^{o}C measurements a Pt-100 temp. probe (PM9249 e.g.) must be used.
The measured analog signals are multiplexed, and via an ADC and a buffer sent to the microprocessor.

The digital part has as most important; the microprocessor (8031).
The microprocessor takes care, together with the software in the ROM (and RAM) that the instructions are carried out.
It communicates via I^2C bus. Also there are possibilities for connecting instruments with an IEC-625 and IEEE-488 bus.
System 21 can be connected as well.
In event of a microprocessor failure that mixes data and adresses the watchdog takes care of automatic initialisation. This causes an interrupt on the microprocessor.

The display is an LCD display and consist of 7 segments - and two numeric displays. It contains also status indicators.
The keyboard consists of sixteen pushbuttons to control and select the functions.

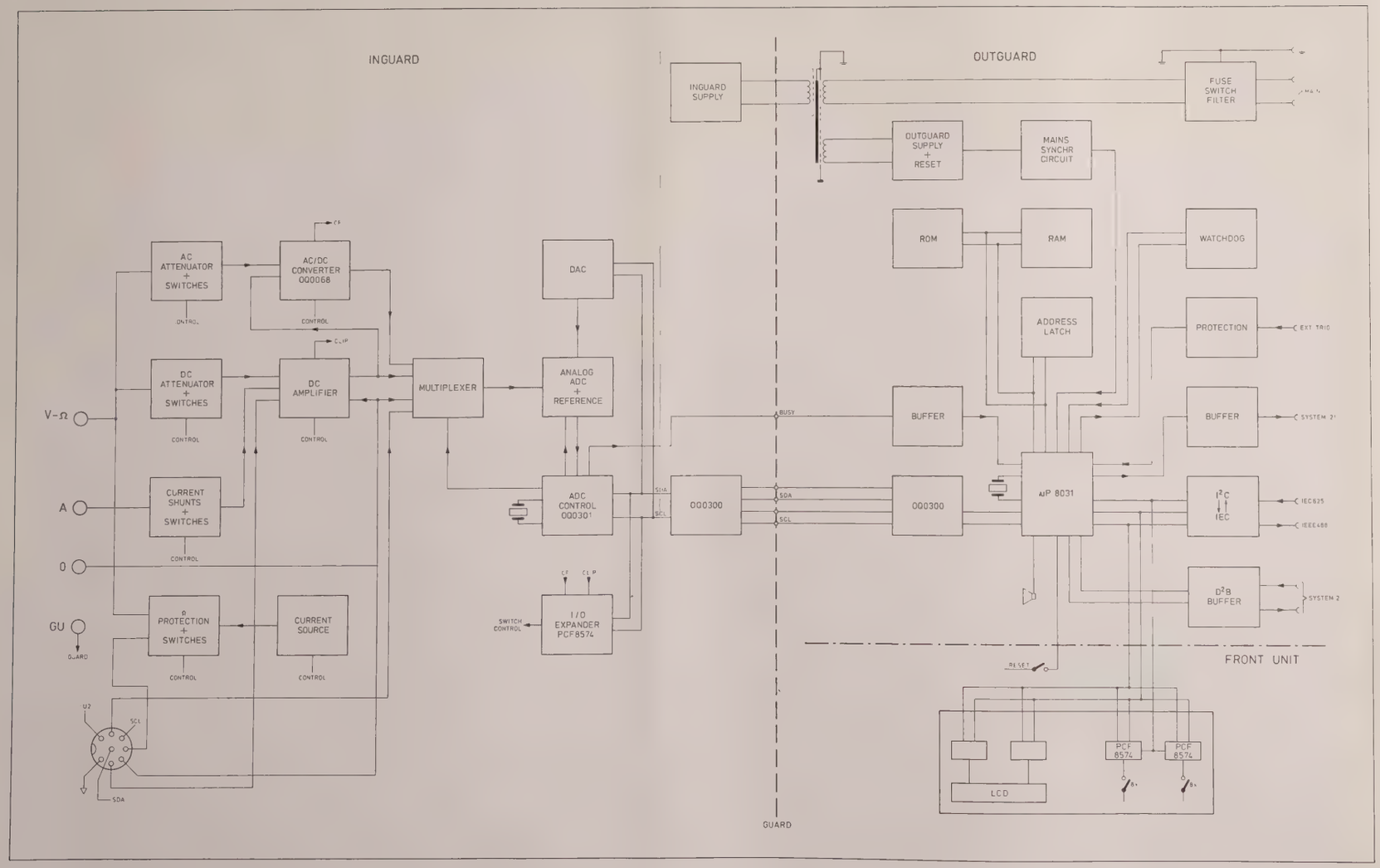


Figure 3.1

3.2 DETAILED DESCRIPTION

The PM2534 automatic multimeter can be subdivided into four functional sections, which are:

1. Analog section
2. Digital section
3. Interface
4. Display/keyboard section

The Analog section and the ADC are situated in the inguard section. The inguard section is the part of the instrument situated in an additional screening. The control section, display keyboard section and the interfaces are situated in the outguard section.

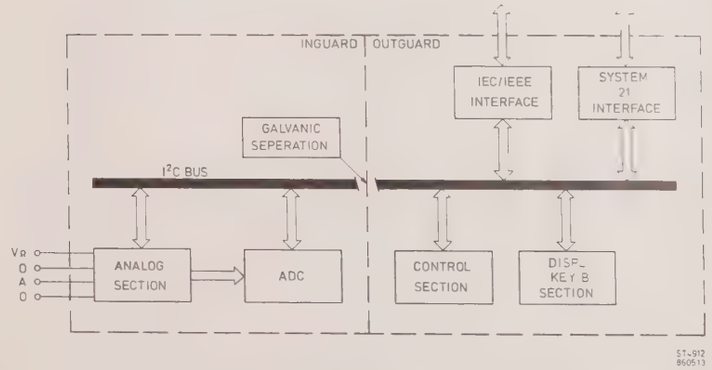


Figure 3.2 Block diagram

3.3 ANALOG SECTION

General

The analog section converts all the quantities to be measured into DC voltages which are then applied via a DC amplifier, or an AC amplifier and RMS converter, (in case of AC quantities) to the analog-digital converter (ADC).

All measuring functions are manually selected, but microprocessor controlled. The ranges can either be selected manually or automatically, also microprocessor controlled.

It is possible to start a measurement on the instrument and a provision is made to start external (TRIGGER).

3.3.1 V ⎓ measurement

The input DC voltage to be measured is applied to a DC attenuator and a DC amplifier:

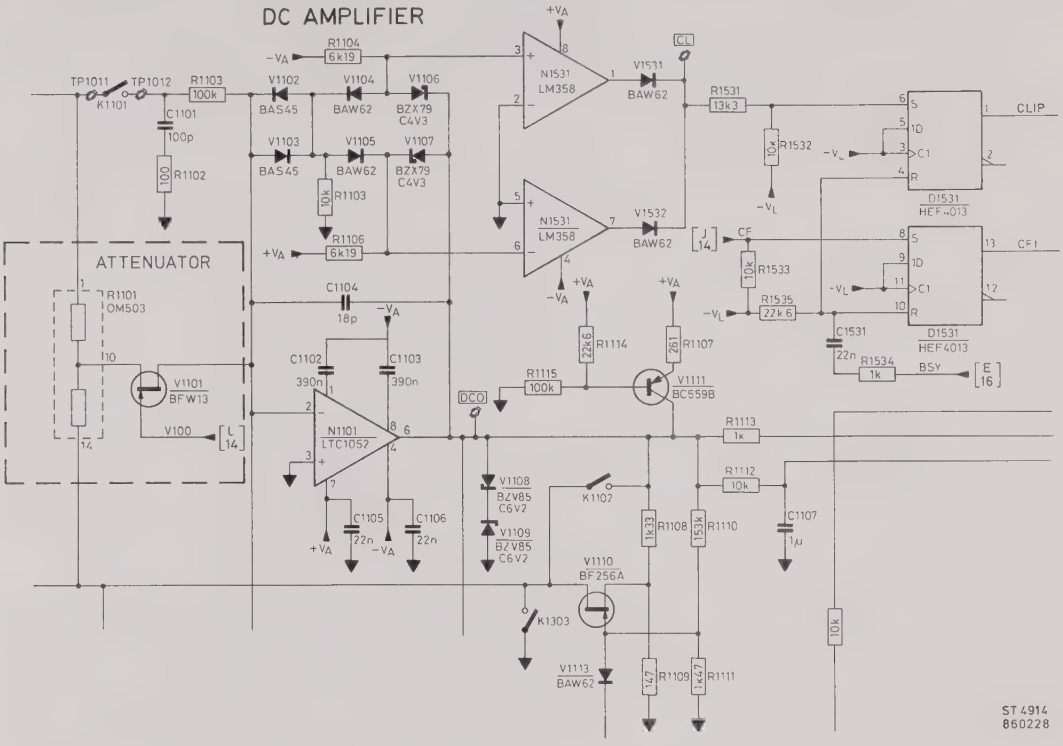


Figure 3.3 V ⎓ measurements

The attenuator is a thin film resistor network (R1101). The attenuation is switched by FET (V1101), amplification is switched by reed relay (K1102), both are controlled by microprocessor.

The combination of attenuation and amplification gives the ranges.

Range	Attn.	GAIN DC AMPL.	Range end
300 mV	1	10	
3 V	1	1	-3 V
30 V	100	10	
300 V	100	1	

A DC voltage of -3 V is applied to the ADC at positive input voltage.

The DC amplifier is a chopper-stabilised, low drift amplifier. It uses an integrated switching oscillator to chop the DC signal into a square wave. This signal can be amplified more easily. An equivalent drift voltage of approximately 0,01 $\mu V/^{o}C$ can be obtained in this way. The DC input is chopped by an electronic switch, amplified and fed back to compensate for the offset voltage due to temperature drift.
The principle of the DC amplifier is shown in a simple diagram.

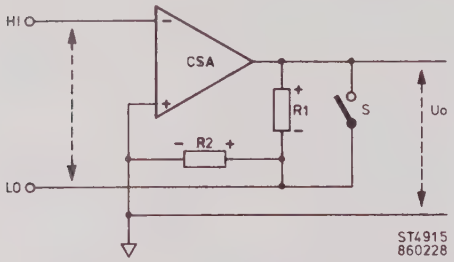


Figure 3.4 DC amplifier principle

The chopper-stabilised amplifier is a negative feedback amplifier, with a virtual earth.
When the switch is open, the gain is 10, when closed, the gain is 1.

NOTE: The LO input is not connected to circuit zero.

The resistors R1108 and R1109 are used to give an amplification of 10 (K1102 open) and an amplification of 1 (K1102 closed).
V1110 is closed before K1102 opens (make before break) to get always a defined amplification. R1110 and R1111 are used to give the gate of V1110 the same voltage as the source, so Ugs = 0V.
The current delivered by the chopper amplifier is too low, so V1111 is used to help the chopper amplifier.

Protection.
When a higher voltage is on the input sockets, than the range allows, the voltage on pin 6 of N1101 drifts to -4,5 V or +4,5 V (depending on the polarity of the input signal).
The result is that diodes V1102, V1104 and V1106 will conduct, and the voltage on pin 6 is clamped.
When the diodes start conducting, the output of the comparator (N1531) changes and this state is kept by the flip-flop D1531. It is indicated on the display as ↑ clipping, BSY will reset this (end of measurement).

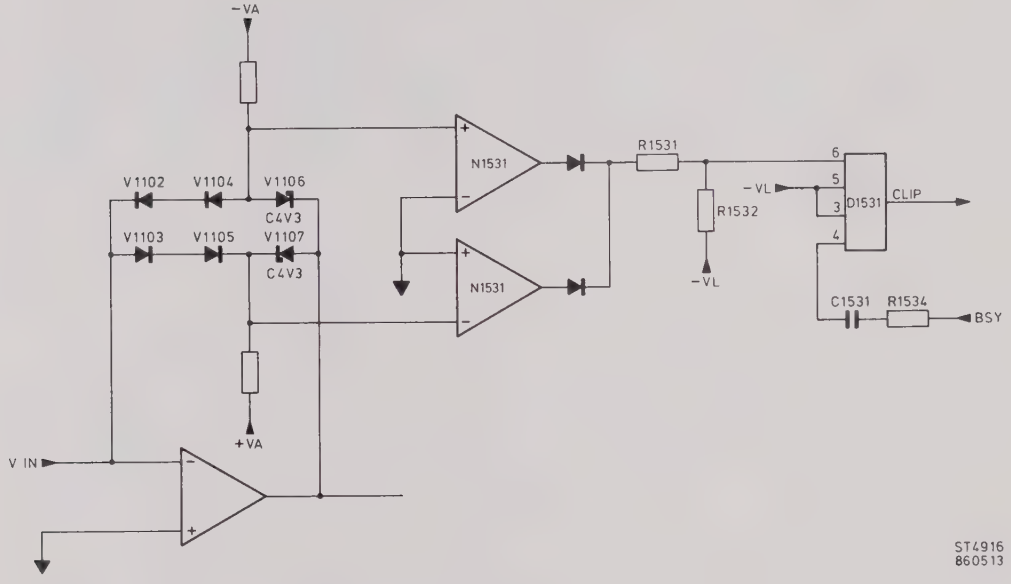


Figure 3.5 Clip indication

3.3.2 V~ measurement

The input voltage to be measured is applied to the AC voltage attenuator where, by means of a RC networks switched by a FET, the attenuation factor is changed (figure 3.6).
The attenuated signal is then passed to the RMS converter which produces a DC signal between 0 and 3 V depending on the RNG input.

When measuring AC voltages, the series capacitor blocks any DC input.
The 100x attenuation is achieved by V1301.

RANGE	ATTN.	0Q0068 sensitivity	RANGE END
300 mV	1	300 mV	
3 V	1	3 V	
30 V	100	300 mV	3 V
300 V	100	3 V	

In the RMS converter the difference between I_1, and I_2 is converted into current in a dual V - I converter. The current is determined by Vin/R and the state of the RNG signal (where R is either R1308 or R1309). This RNG selects the input sensitivity of the RMS converter. The current in the AC-to-DC converter is rectified and then converted into a current again by the RMS section.
This current is proportional to the RMS value of the input signal. Capacitor C1311 and C1310 provide the automatic zero (AZC) compensation for the RMS converter. The output of the RMS converter is converted into a voltage by resistor R1310. In the RMS converter there is also an output to indicate whether the crest factor has been exceeded. When point 9 of the OQ0068 becomes logic 1, the CF (point 9) indicates via latch D1531 to the microcomputer that the crest factor is exceeded. K1303 is closed during measurement.
With the filter pushbutton the measurable frequency range is shifted from 400 Hz (filter off) to 40 HZ (filter on). This is achieved with V1303 and V1304 which switch additional capacitors into the RMS circuit.

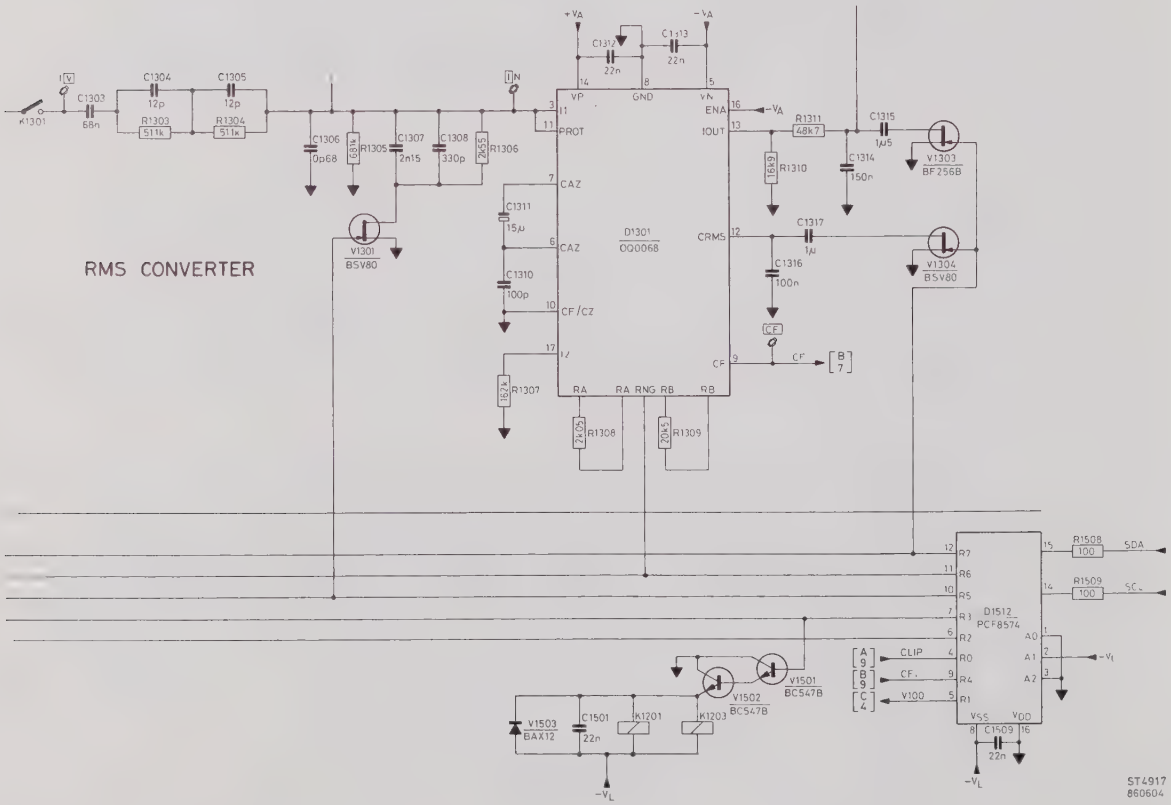


Figure 3.6 RMS converter

3.3.3 DC/AC current measurements

In the function A, two ranges are available (30 mA and 3 A). The ranges are determined by shunt R1153 and the input impedance of the ADC. The ranges are protected by fuse F1102. If the voltage across NTC R1152 becomes too high, the thyristor starts conducting and the fuse will blow.

Range	Shunt	DC ampl
+ 30 mA	150 mV	10x
+ 3 A	150 mV	10x

The AC input current ranges are shunted in the same way as the DC currents. The voltage from the shunt is supplied to the I_1 input of the RMS converter. Input I_2 of the 0Q0068 is earthed via resistor R1307.

Range	Shunt	sensitivity via 0Q0068
30 mA	150 mV	0,3 V
3 A	150 mV	3 V

3.3.4 Resistance measurement

The unknown resistance is connected between VΩ and 0 V input sockets and supplied internally by a constant current source (figure 3.7). This current results in a potential difference across the resistor that is proportional to the resistance value.

The unknown resistance may either be connected to the VΩ input socket for two wire measurements in this way, or connected in a bridge (4-wire) configuration to the Probe socket using a four-wire test lead.

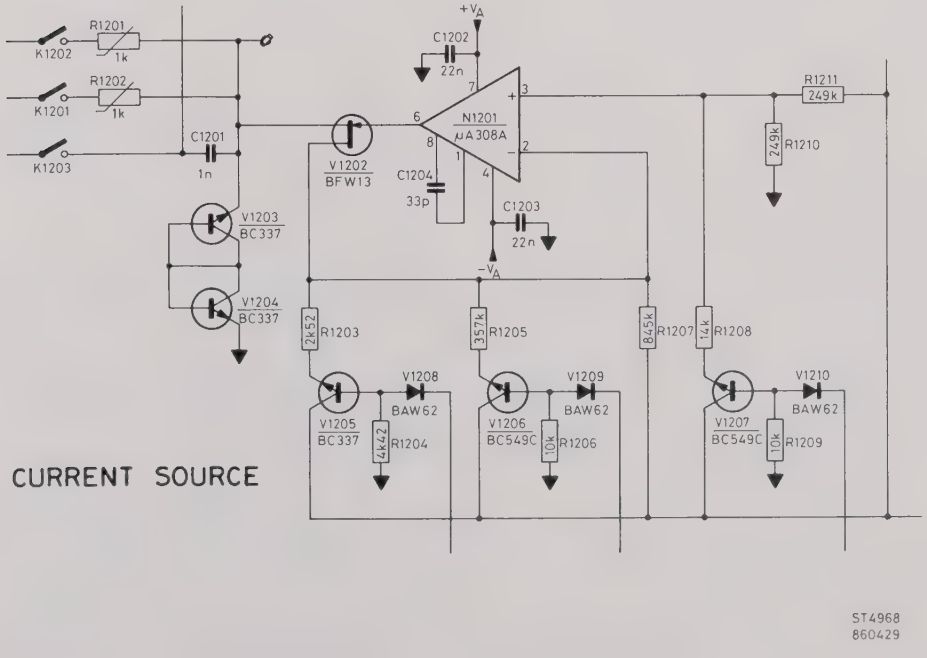


Figure 3.7 Current source

The measuring currents are derived from the current source which is built around N2101. By switching resistors in the feedback of this opamp it will change the currents.

RANGE	MEASURING CURRENT
3 kΩ	1 mA
30 kΩ	100 µA
300 kΩ	10 µA
3 MΩ	1 µA
30 MΩ	300 nA
300 MΩ	300 nA

On pin 3 half of the negative reference voltage is present. As the amplification of opamp N1201 is 1, the voltage across R1207 is 5 V : 2 = 2.5 V. This is valid when V1207 is closed. If transistor V1207 conducts, the voltage across R1207 will decrease to 250 mV. Depending on whether transistor V1205 and/or V1206 is openend, the current through the unknown resistor is changed or constant.

For 2-wire measurement, K1202 is closed, K1201 and K1203 are closed to perform 4-wire measurements. In this case (4-wire) the resistance of the measuring leads is compensated.

3.3.5 Temperature measurement

When ^{o}C is selected, the constant current 1 mA is routed from pin 2 of the probe connector X201 or X202, which is connected via the probe to one end of the Pt-100 resistance thermometer. The other lead is connected to earth. This current gives a voltage drop which depends on the resistance value across the Pt-100 probe.
The voltage drop is measured via two other points of X201 or X202 (4-wire measurement). 0^{o}C will give a voltage of 100 mV. The 100 mV offset is subtracted in the microcomputer so that 0^{o}C will be displayed.

3.3.6 Multiplexer

All the measuring signals are supplied to a multiplexer. This multiplexer connects one input to the output (D1402 pin 3), depending on the code on pins 11, 10 and 9 of D4051. The signals are indirectly controlled by the µP.

3.3.7 Control of Analog Section

The selection of the analog measuring functions is made under µP control by the manually-selected or remote commands from the keyboard or interface.
Analog control actions are carried out from the µP.
These actions are performed with the aid of an $I^{2}C$ device (I/O expander) and a part of the OQ0301.

3.3.8 Guard circuit

The front-panel guard can be internally connected (via a switch) to a shield that isolates the 0 (Lo) input socket of the PM2534 from ground (earth).
This shield increases the impedance between the LO terminal and ground to improve common-mode rejection, which gives an improved measuring acurracy, especially for small input signal.

The guard should be connected to the same input potential as the Lo input terminal. For asymmetrical inputs, this will usually be earth.

3.3.9 Analog to Digital conversion. (ADC)

3.3.9.1 General

The ADC converts the analog quantities to be measured into their digital equivalents for measurement by the µP. The operating and timing functions for the ADC are derived from the µP via the 0Q0301. The basic principle used for the ADC is the conversion of analog signals into digital form by integration (the dual slope system).

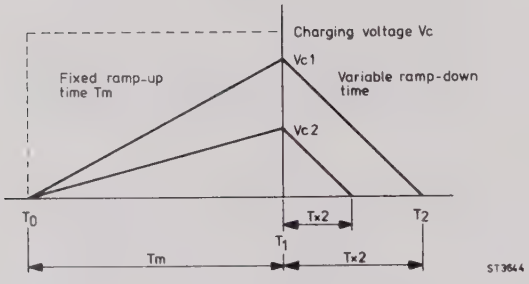


Figure 3.8 Dual slope system

3.3.9.2 ADC principle

The quantity to be measured (the unknown voltage Vx presented to the input) is applied together with a precise reference voltage via switching circuits to an integrator stage. This integrator is followed by a comparator, as shown:

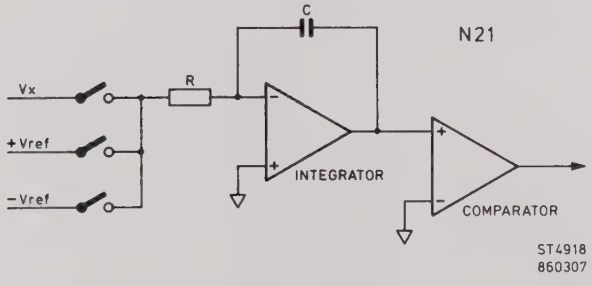


Figure 3.9 ADC principle

The integrator is charged linearly via the switch for a fixed time by an unknown voltage V_x, and then discharged over a variable time T_x by the reference voltage V_{ref}.
If the value of Vx is different, then the charging voltage amplitude is different (Vc2) and consequently the time taken to discharge is different. The fixed charging time Tm (ramp-up time) is measured by counting a pre-determined number of pulses in a counter (0Q0301). This counter is then used to count the number of pulses during the discharge time Tx (ramp-down time). The END of the ramp-down phase is detected by the comparator. This detection occurs as the integrator voltage reaches zero volts.
At the END of the ramp-up time, the polarity of the comparator output determines which reference voltage, + Vref or- Vref has to be chosen in the ramp-down period.
This depends on the input signal: a negative signal requires a positive reference voltage and vice versa.

3.3.9.3 Automatic zero

Incorrect Zero-crossing of the comparator can occur after the ramp-down phase because of drift offsets in the integrator and comparator circuits. This is eliminated in practice by automatic zero correction. During the AZC phase, the input of the integrator is short-circuited and any offset voltage of the integrator and comparator is loaded into a capacitor. This offset voltage is substracted or added depending on polarity at the result.

3.3.9.4 DAC

A DAC is added in the ADC circuit to obtain higher resolution. The zero of the ADC is shifted every measurement to obtain the last digit of the reading.

Assume that the first measurement consist of 18201 points. After ten measurement the reading still will be 18201. By shifting the zero of the ADC in a positive or negative direction an extra digit is obtained. The counter which counts the pulses during the ramp-down period is stopped if the ramp-down signal crosses the zero. When the zero is next shifted the crossing will be on another point. If this is done ten times then there are also results with 18200 points. Adding these results and dividing them by 10 will give a reading with an extra digit.
In speed 1, 100 results are used in a similar way to obtain the last two digits.

3.3.10 Reference Voltage (Source + 5 V and - 5 V)

The reference voltage source circuit is shown in figure 3.10.

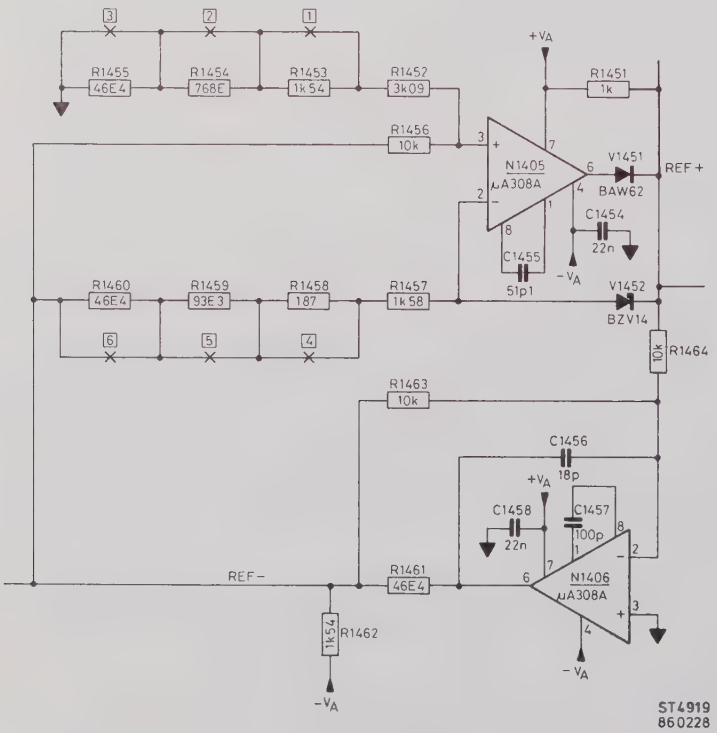


Figure 3.10 Reference Voltage

The current through V1452 must be 2 mA. This is performed with R1457, R1458, R1459 and R1460. The voltage drop is then 6,5 V with a very low temperature coefficient. The cathode of V1452 will be + 5 V, so between pin 2 and pin 3 must be 1,5 V.
The negative voltage is made with an inverter. The + 5 V is supplied to pin 2 from the N1406, and the output will be - 5 V.
The resistors R1453, R1455, R1458 and R1460 are for adjustment.

3.3.11 Inguard-outguard connection

To reduce the influence of inteference between the measuring circuits (INGUARD) and the digital circuits (OUTGUARD) the PM2534 is provided with a galvanic separation.

The galvanic separation consists of opto-couplers (H1802 - H1805). The communication between inguard and outguard is provided by the I^2C bus.
On the bus the traffic is bi-directional. Two opto-couplers are used for the SCL line, and two opto-couplers are used for the SDA line. One optocoupler is used to indicate that the ADC is ready with a measurement. The OQ0300's are used to control the direction on the bus.

3.4 DIGITAL SECTION

The PM2534 uses the 8031 microcomputer and one ROM in the digital part to control the multimeter.
(For details of the 8031 refer to section 3.7.1)

3.4.1 Software description

The software carries out some routines to measure and evaluate the applied input signal. The main tasks of the software are mentioned here:

1. Output/input to the IEEE-488/IEC-625 interface.
2. Carry out the different trigger modes.
3. Perform the status byte.
4. Translate the input of the interface to a internal code.
5. Carry out all System 21 actions.
6. Read the function switch, data-hold probe etc.
7. Measure the input signal.

The last action can be subdivided into the following flow-chart.

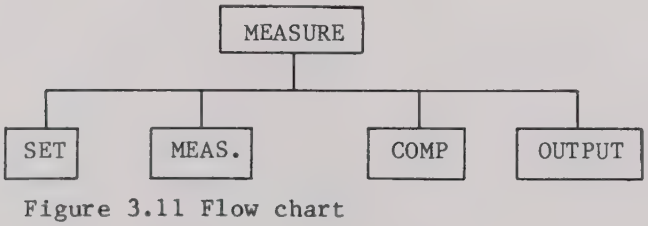


Figure 3.11 Flow chart

The routines outlined in the main flow-chart can be outlined as follows.

SET-UP routine	This routine sets-up the OQ 0301. The microcomputer reads the calibrated value out of the RAM and sends it to the OQ 0301. The relay and FET switches in the analog part are set.
Measure routine	In this routine the PM2534 is measuring. It starts the measurement and collects the counts of the OQ 0301.
Calculate routine	This routine obtains the final measuring value from the following calculations. The following calculations may be made: - Calculate the temperature in the ^{o}C function (linearisation) - Calculate with the offset (substract from measured value)
Output routine	The output routine translates the measure result to ASCII for display or interfaces.

3.4.2 RAM/ROM

The PM2534 has a RAM of 2 kbytes. In this RAM all the calibration values are stored. A battery G1601 supplies the RAM if the power is switched off. In the PM2535 a RAM of 8 kbytes is used. In this RAM, additional information is stored like burst measurements and sequence parameters.

The read only memory is a 16 kbyte ROM in case of a PM2534 or a 32 kbyte ROM in case of a PM2535. The addressing and output of data bytes takes place via the data bus. The chip select is derived from signal PSEN, program store enable.

External trigger circuit

Via the external trigger input a measurement can be started. When the input is pulled down, a pulse on pin 9 of D 1802 will interrupt the processor. After the interrupt, the processor starts a new measurement.

3.4.3 I^2C bus

The I^2C bus differs considerably from the conventional bus structures in that data-transfer is effected in a bit-serial, rather than in byte-parallel format.
In a conventional microcomputer such as the 8048 for instance, 12 address, 8 data and 4 control lines are necessary for parallel data transfer. The I^2C 8440 microcomputer on the other hand requires only 2 lines to transfer serially the same amount of data. Chips used for ADC, RAM and LCD drivers are I^2C compatible and also use the same two lines.
These two lines are respectively the SDL (serial data line) and the SCL (serial clock line), the function of which is to synchronise data-transfer between the appropriate I^2C devices.

Almost any number of devices can be connected to the I^2C bus. Each device is allocated its own specific 7-bit address which enables any two of these devices to communicate with each other upon receipt of a message prefixed with the appropriate 7-bit address.
This specific 7-bit address usually comprises a fixed address part (4 bits) and a user definable part (3 bits).
The latter is assignable by tying "Define Address" pins to high or low levels.
Address recognition is effected in the I^2C interface hardware of each device and this eleminates the need for decoding logic. The use of an automatically invoked arbitration procedure, which prevents two or more devices from transmitting simultaneously, makes I^2C technology eminently suitable for a multiprocessor system.

For further information about I^2C see: Philips Data Handbook: Integrated circuits for digital systems in radio, audio and video equipment.

3.5 IEEE/IEC INTERFACE

The IEEE/IEC interface processor communicates with the main processor via the I^2C bus. It acts as a slave of the main processor. This interface processor handles the complete handshake of the IEC/IEEE interface.

3.5.1 Receiving

If the system controller sends a listen address (MLA) via the DIO lines (ATN is true), D1905 and D1906 are switched to the receive direction. Also via the hardware NDAC (no data accepted) is generated. The TA (talker active) signal is high so that the input of D1905 and D1906 (Special GPIB devices) is low. This means that a part of D602 acts as input and another part as output.

D1602
- Outputs: NDAC, NRFD, SRQ
- Inputs: DAV, REN, ATN, EOI, IFC

Then the microcomputer starts handshaking the device address on the bus. If the device address on the bus is the same as the device address selected, the microprocessor starts to handshake in the other data bytes.

3.5.2 Transmitting

After the microcomputer has received MTA (my talk address) or in talk-only mode as described, the interface becomes talker. This means that D1905 and D1906 are now transmitters. The bytes on P0 are now data for the controller. If the interface becomes talker, it makes P13 low.

The GPIB device D 1906 is switched to the following configuration.

D1906
- Outputs: DAV, SRQ, EOI
- Inputs: NDAC, NRFD, REN, ATN, IFC

The PM2534 is now handshaking so that the bytes are sent to a controller or another device. At the end of the databytes the PM2534 generates EOI. The interface will remain talker until the Listener address is again on the bus, or after an IFC command is connected to the interrrupt system of the interface.

3.6 DISPLAY/KEYBOARD

The PCF 8576 is a circuit designed to drive a Liquid Crystal Display with up to 160 segments. A 2-line I^2C bus structure enables serial data transfer with the microcomputer.
A LCD is an AC device. Therefore, for multiplexing, the information of the segment line is important for each segment that will be driven by that line.
The reference voltage for the driver is obtained from transistor V2102 and zener diode V2101.
To change the viewing angle the reference voltage can be adjusted with potentiometer R2105.

On the same PCB the keyboard is situated. Pushing a switch will be read by the microcomputer via the I^2C bus. This is done by scanning lines P0 to P7 to obtain which switch is pressed.

3.7 DATA OF COMPONENTS

3.7.1 8031AH single-component 8-bit microcomputer

- 8031AH - Control-Oriented CPU with RAM and I/O
- 128K Accessible External Memory
- 218 User Bit-Addressable Locations
- 128 x 8 RAM
- 32 I/O Lines (Four 8-Bit Ports)
- Two 16-Bit Timer/Counters
- Programmable Full-Duplex Serial Channel

The 8031AH is Intel´s HMOS version of the High performance 8-bit 8031 microcomputer. While the 8031AH features the same powerful architecture and instruction set as its HMOS predecessor, it offers the additional benefit of lower power supply current.

The 8031AH provides a cost-effective solution for those controller applications requiring up to 64 Kbytes of program and/or 64 Kbytes of data storage. Specifically, the 8031AH contains 128 bytes of read/write data memory; 32 I/O lines configured as four 8-bit parallel ports; two 16-bit timer/counters.

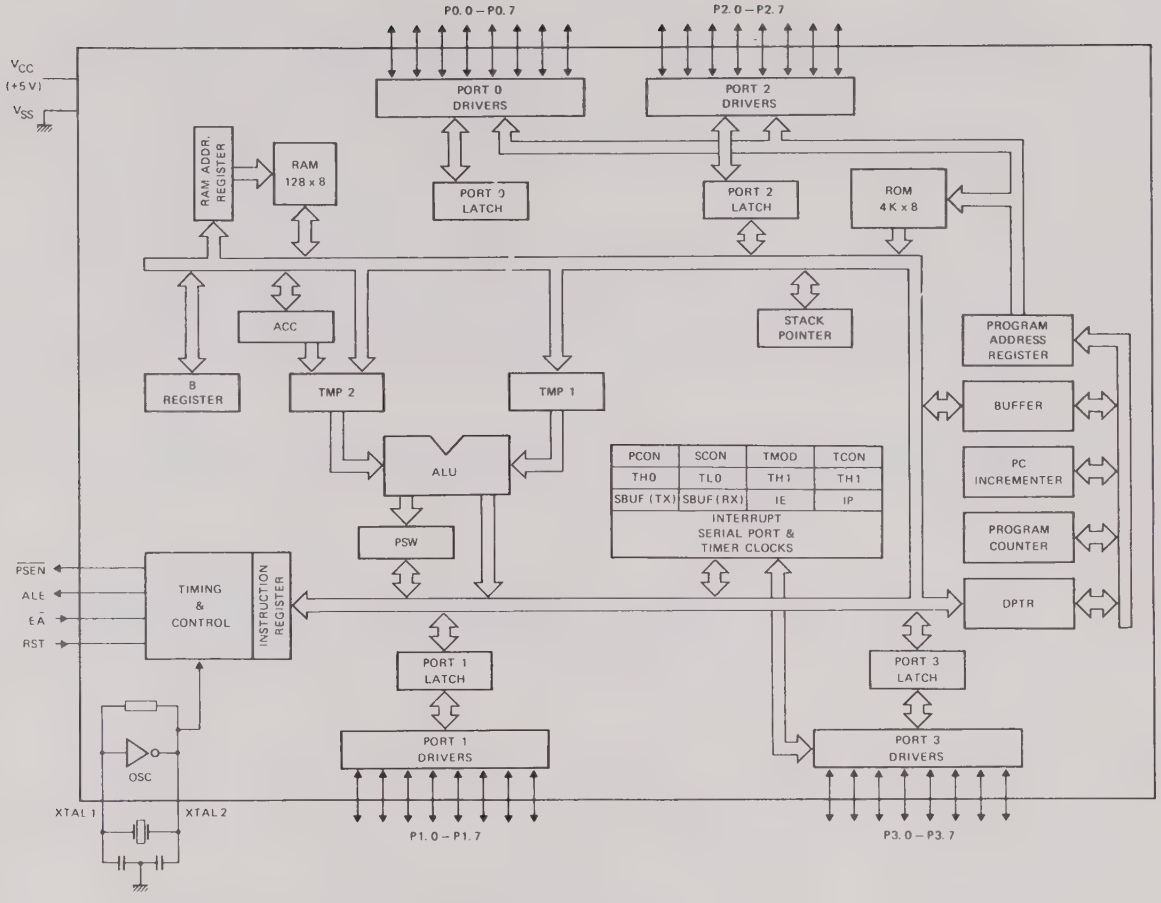


Figure 3.12 Block Diagram

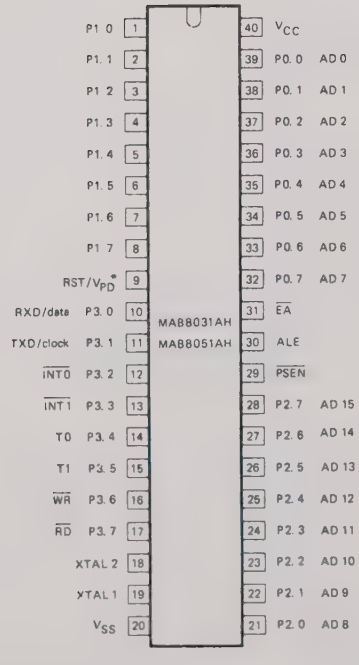


Figure 3.13 Pin Configuration

8031AH PIN DESCRIPTIONS

V_{SS}
Circuit ground potential.

V_{CC}
5V power supply input for normal operation and program verification.

Port 0
Port 0 is an 8-bit open drain bidirectional I/O port. It is also the multiplexed low-order address and data bus when using external memory. It is used for data output during program verification. Port 0 can sink (and in bus operations can source) eight LS TTL loads.

Port 1
Port 1 is an 8-bit quasi-bidirectional I/O port. It is also used for the low-order address byte during program verification. Port 1 can sink/source four LS TTL loads.

Port 2
Port 2 is an 8-bit quasi-bidirectional I/O port. It also emits the high-order address byte when accessing external memory. It is used for the high-order address and the control signals during program verification. Port 2 can sink/source four LS TTL loads.

Port 3
Port 3 is an 8-bit bidirectional I/O port with internal pullups. It also serves the functions of various special features of the MCS-51 Family, as listed below:

Port Pin	Alternate Function
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	INT0 (external interrupt)
P3.3	INT1 (external interrupt)
P3.4	T0 (Timer/counter 0 external input)
P3.5	T1 (Timer/counter 1 external input)
P3.6	WR (external Data Memory write strobe)
P3.7	RD (external Data Memory read strobe)

The output latch corresponding to a secondary function must be programmed to a one (1) for that function to operate. Port 3 can sink/source four LS TTL loads.

RST
A high on this pin for two machine cycles while the oscillator is running resets the device. A small external pulldown resistor (~8.2kΩ) from RST to V_{SS} permits power on reset when a capacitor (~10μF) is also connected from this pin to V_{CC}.

ALE
Address Latch Enable output for latching the low byte of the address during accesses to external memory. ALE is activated at a constant rate of 1/6 the oscillator frequency except during an external data memory access at which time one ALE pulse is skipped. ALE can sink/source 8 LS TTL inputs.

PSEN
The Program Store Enable output is a control signal that enables the external Program Memory to the bus during external fetch operations. It is activated every six oscillator periods except during external data memory access. PSEN remains high during internal program execution.

EA
When held at a TTL high level, the 8051AH executes instructions from the internal ROM when the PC is less than 4096. When held at a TTL-low level, the 8031AH/8051AH fetches all instructions from external Program Memory. Do not float EA during normal operation.

XTAL 1
Input to the inverting amplifier that forms part of the oscillator. This pin should be connected to ground when an external oscillator is used.

XTAL 2
Output of the inverting amplifier that forms part of the oscillator, and input to the oscillator signal when an external oscillator is used.

3.7.2 MAF 8441 single-chip 8-bit microcontroller

DESCRIPTION

The MAB/F8441 is a device with 4K ROM/128 RAM bytes plus 8-bit LED-driver

It has 20 quasi-bidirectional I/O port lines, one serial I/O line, one single-level vectored interrupt, an 8-bit timer event counter and on-board clock oscillator and clock circuits.

This microcontroller is designed to be an efficient controller as well as an arithmetic processor. The microcontrollers have extensive bit handling abilities and facilities for both binary and BCD arithmetic.

For detailed informations see the "Users manual Single-chip microcomputers".

Features:

- 8-bit: CPU, ROM, RAM and I/O in a single 28-lead DIL package
- 128 RAM bytes
- 20 quasi-bidirectional I/O port lines
- Two testable inputs: one of which can be used to detect zero cross-over, the other is also the external interrupt input
- Serial I/O that can be used in single or multi-master systems (serial I/O data via an existing port line and clock via a dedicated line)
- Internal oscillator, generated with inductor, crystal, ceramic resonator or external source
- Over 80 instructions all of 1 or 2 cycles
- Single 5 V power supply (± 10%)

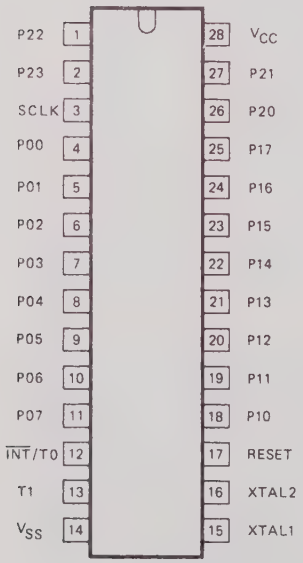


Figure 3.14 Pinning

PINNING	DESIGNATION	
V_{SS}	14	Ground
V_{CC}	28	Power supply, + 5 V
P00-P07	4-11	Port 0, 8-bit quasi-bidirectional I/O port
P10-P17	18-25	Port 1, 8-bit quasi-bidirectional I/O port
P20-P23	26, 27, 1, 2	Port 2, 4-bit zuasi-bidirectional I/O port; P23 is the serial data I/O in serial I/O mode
SCLK	3	Bidirectional clock for serial I/O
INT/T0	12	External interrupt input (sensitive to a negative-going edge min LOW > 7 clock pulses, min HIGH > 4 clock pulses), testable using the JT0 or JNT0 instructions.
T1	13	Input pin, testable using the JT1 or JNT1 instructions. It can be designated as event counter input using the STRT CNT instruction. It can also be used to detect zero cross-over of slowly moving AC inputs.
RESET	17	Input to initialize the processor (active HIGH).
XTAL1	15	Connection to timing component (crystal) that determines the frequency of the internal oscillator. It is also the input for an external clock source.
XTAL2	16	Connection to other side of the timing component.

3.7.3 D/A convertor DAC-08 E

DESCRIPTION

The DAC-08 series of 8-bit monolithic digital-to-analog converters provide very high-speed performance coupled with outstanding applications flexibility.

Advanced circuit design achieves 85ns setting times with very low "glitch" energy and at low power consumption.

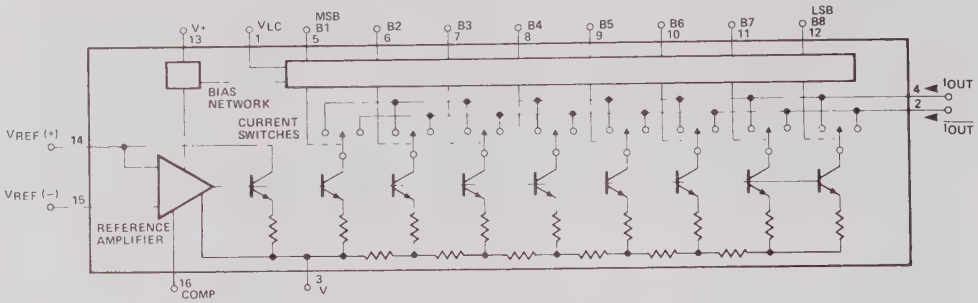


Figure 3.15 Block diagram

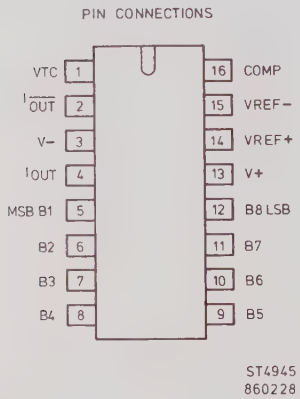


Figure 3.16 Pin connections

3.7.4 TL7705A, supply voltage supervisor

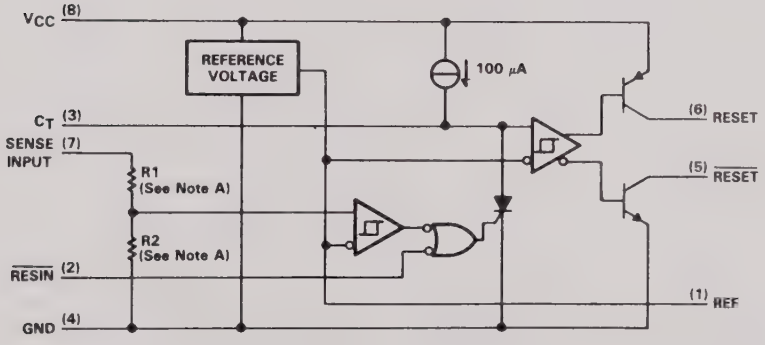
- Power-On Reset Generator
- Automatic Reset Generation After Voltage Drop
- Wide Supply Voltage Range ... 3 V to 18 V
- Precision Voltage Sensor
- Temperature-Compenstated Voltage Reference
- True and Complement Reset Outputs
- Externally Adjustable Pulse Width

Description

The TL7702A series are monolithic integrated circuit supply voltage supervisors specifically designed for use as reset controllers in microcomputer and microprocessor systems. During power-up the device tests the supply voltage and keeps the RESET and RESET outputs active (high and low, respectively) as long as the supply voltage has not reached its nominal voltage value. Taking RESIN low has the same effect. To ensure that the microcomputer system has reset, the TL7702A then initiates an internal time delay that delays the return of the reset outputs to their inactive states. Since the time delay for most microcomputers and microprocessors is in the order of several machine cycles, the device internal time delay is determined by an external capacitor connected to the D_T input (pin 3).

$$t_d = 1.3 \times 10^4 \times C_T$$

Where: C_T is in farads (F) and t_d is in seconds(s)



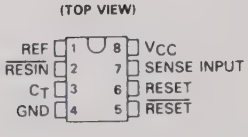


Figure 3.17 Functional block diagram

3.7.5 OM 503 Thin Film resistor network

This is a specially-made resistor network.

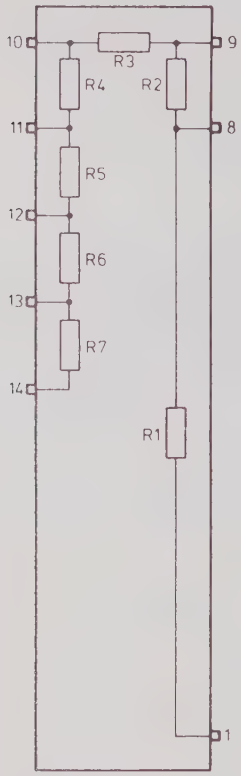


Figure 3.18

Resistor values

Name	nom. value	abs. tol.
R1	8998K	0,8 %
R2	4K668	2 %
R3	898K	0,95 %
R4	518E4	2 %
R5	89K78	0,95 %
R6	52K32	2 %
R7	9K98	0,95 %

3.7.6 SA 1045 P D^2B driver comparator circuit

FUNCTION : Driver comparator Circuit for Domestic Digital Bus D^2B.

PACKAGE : 8 pins plastic DIL SOT97C.1

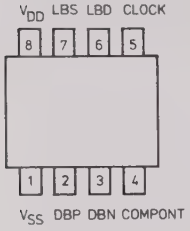


Figure 3.19

PINNING

PIN	SIGNAL	TYPE		
1	V_{SS}	0 V Supply		
2	DBP	ODP/CI	IP	Input
3	DBN	ODN/CI	CI	Comparator Input
4	Compout	OP	OP	Push-pull Output
5	clock	IP	ODN	Open Drain N-output
6	LBD	IP	ODP	Open Drain P-output
7	LBS	OP		
8	V_{DD}	+ Supply		

The driver / detector chip consists of 3 main blocks:
-1- analog driver / detector
-2- digital filter
-3- power-on-reset

1. The analogue driver / detector is a copy of the same part in the D^2B-IC. It performs the driving and sensing of the D^2B-lines. The sensing happens on certain levels with a certain hysteresis over a high common-mode-range. The driver is either tri-state or puts defined levels on the lines. This part meets the electrical D^2B-specification.

2. The digital filter cannot follow high frequent changes on the bus lines and so performs the necessary noise-reduction. The input data must be stable within 2 clocks or it is not taken in.

3. The power-on-resets the whole chip at power-on. It resets the filter and switches off the analogue part.

   The driver can be controlled by signal LBD, the output of the detection is LBS. DBN and DBP is the bus line I/O and Compout is the direct comparator output.

3.7.7 OQ0300 bus control

Description

The OQ0300 consists of two equal circuits with a common supply current source and voltage reference.
Each of these equal circuits interfaces one of the I^2C bus lines to a pair of opto-couplers. One of these couplers transmits the I^2C information to the other side of the galvanic separation while the other coupler receives information from the other side of the galvanic separation.

In case of a multimaster system, attention should be given to the the over all propagation delay of the galvanic separation.

The OQ0300 can be adapted to the dark current - light current ratio of the photodiode used in the optocoupler.

The enable input enables both LED driver stages.

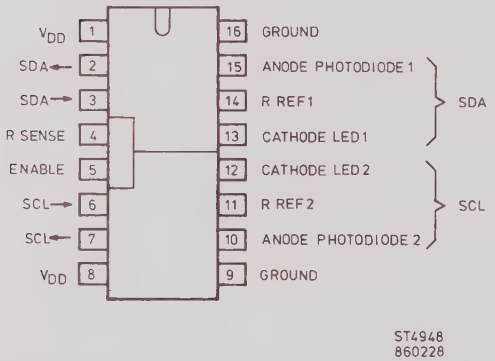


Figure 3.20 Pinning

3.7.8 OQ 0301 ADC Control

General

The OQ0301 is designed as an ADC control circuit for a 3-phase integrating ADC system with I^2C compatible serial data transfer.
It contains three 24-bit serial in-parallel out shift register, a 23-bit synchronous counter which can be parallel loaded from one of the 3 shift-registers, a 24-bit parallel in-serial out shift-register for reading the result of the counter and a full comparator for timing possibilities of the counter.
Further, it contains the ADC-control logic for controlling a 3-phase integrating ADC circuit and a clock oscillator controlled by an external crystal.
The OQ0301 has an I^2C-interface (with slave control).
The timing for the several phases is done by the OQ0301 and also the counting of clock pulses for the result of an ADC cycle:

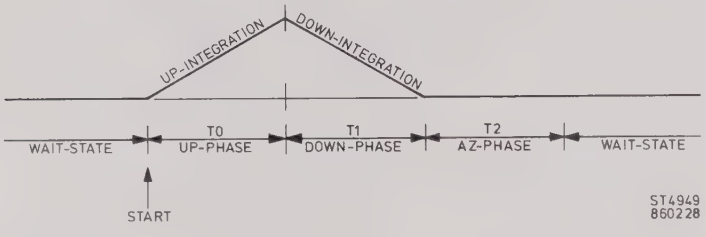


Figure 3.21

If the ADC control is in the WAIT-state a start can be generated and the ADC control starts the UP-phase. The timing of the UP-phase is done by presetting a 23-bit synchronous upcounter and by upcounting until the counter is full.
Then the DOWN-phase is started. In the DOWN-phase the counter counts the clock pulses to get the result and is stopped by a COMP(arator) signal, which comes from the analog ADC-circuit. If in case of a fault the DOWN-phase is not stopped by the COMP signal, it will be stopped when the counter is full (therefore the counter is also presettable for the DOWN-phase to get a defined max. DOWN-timing in case of a fault). When the DOWN-phase is ready, the contents of the counter is transferred to the output shiftregister and the AZ-phase is started. The timing of the AZ-phase is done by presetting the counter and then by upcounting until the counter is full. After the AZ-phase is done, the ADC control goes to the WAIT-state and the next ADC-cycle can be started.

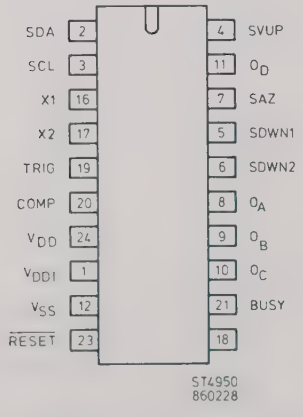


Figure 3.22 Pinning

Inputs	
SDA SCL	I^2C-BUS
X1 X2	CRYSTAL INPUTS FOR INTERNAL OSCILLATOR AND ALSO FOR INPUT OF EXTERNAL CLOCK
TRIG	TRIGGER INPUT
COMP	COMPARTOR INPUT (FROM ADC)
RESET	RESET 0Q0301 (SAME AS POWER ON)
V_{DD} V_{DDI} V_{SS}	SUPPLY

Outputs	
SVUP SAZ SDWN1 SDWN2	ADC CONTROL LINES
O_A O_B O_C O_D	OUTPUTS OR ADC CONTROL LINES (SELECTABLE)
BUSY	OUTPUT LINE FOR DIRECT BUSY OR READY CONTROL

3.7.9 SAA1300 tuner switching circuit

The SAA1300 is used for switching on and off the supply lines of various circuit parts via an I^2C bus signal. It contains 5 output stages which are capable of supplying up to 100 mA in the ON state or sinking up to - 100 µA in the OFF state.
Current limiting and short-circuit protection are included.

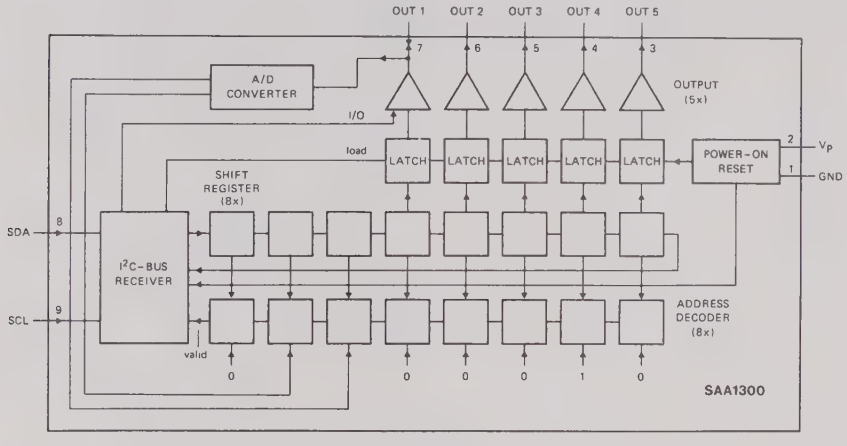


Figure 3.23 Block diagram

PINNING

pin no.	symbol	function
1	GND	ground
2	V_P	positive supply
3	OUT5	outputs
4	OUT4	
5	OUT3	
6	OUT2	
7	OUT1	output and subaddressing input
8	SDA	serial data line (I^2C bus)
9	SCL	serial clock line (I^2C bus)

3.7.10 PCF8574 remote 8-bit I/O for I^2C bus

DESCRIPTION

The PCF8574 is a single-chip silicon gate CMOS circuit. It provides remote I/O expansion for the MAB8400 and PCF8500 microcomputer families via the two-line serial bidirectional bus (I^2C). The device consists of an 8-bit quasi-bidirectional port and an I^2C interface. The PCF8574 has low current consumption and includes latched outputs with high current drive capability for directly driving LEDs.

Features

- Operating supply voltage 2,5 V to 6 V
- Bidirectional expander
- Open drain interrupt output
- 8-bit remote I/O port for the I^2C bus
- Latched outputs with high current drive capability for directly driving LEDs
- Address by 3 hardware address pins for the use of up to 8 devices (up to 16 possible with mask option)

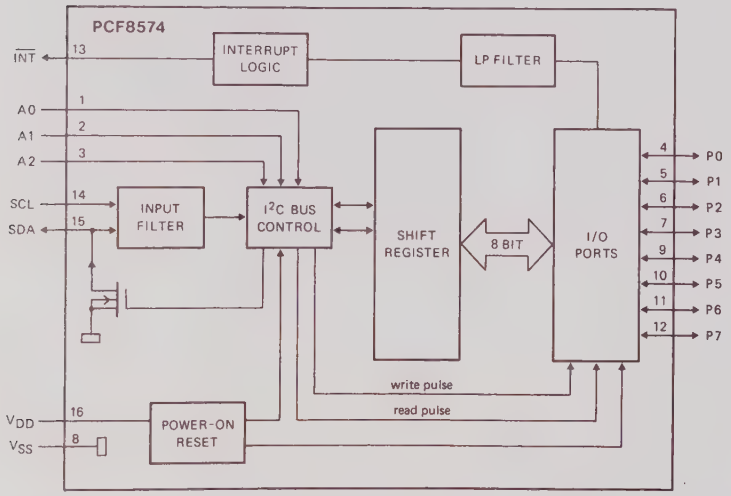


Figure 3.24 Block diagram

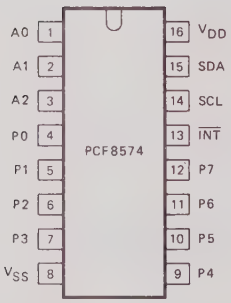


Figure 3.25 Pinning diagram

1 to 3	A0 to A2	address inputs
4 to 7 9 to 12	P0 to P3 P4 to P7	8-bit quasi-bidirectional I/O port
8	V_{SS}	negative supply
13	$\overline{INT}$	interrupt output
14	SCL	serial clock line
15	SDA	serial data line
16	V_{DD}	positive supply

3.7.11 OQ0068A AC/DC convertor (RMS)

DESCRIPTION

The OQ0068 is an integrated AC voltage to DC current converter for use in measuring equipment. The output current is proportional to the RMS value of the input voltage.
Special features are:
- Enable input for power-down mode
- Range input for selection of 2 resistor programmed ranges
- Crest Factor or Zero Crossing output selection
- Low leakage input clamp
- Automatic offset compensation

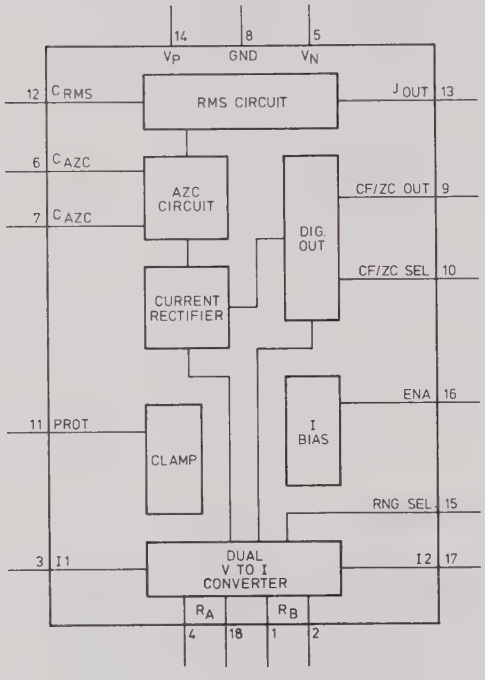


Figure 3.26 Block diagram OQ0068A

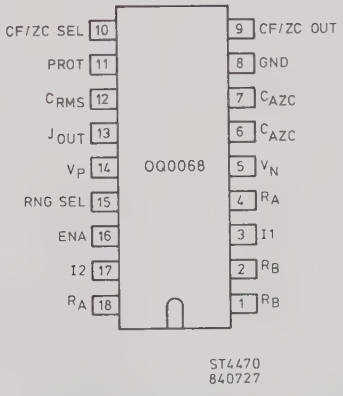


Figure 3.27 Pinning QO0068A

OPERATION MODES

ENA	SEL	CF/ZC	SEL RNG	FUNCTION
1		X	X	Power-down mode
0		1	0	Low range measurement mode
0		1	1	High range measurement mode
0		0	0	Low range Counter mode
0		0	1	High range Counter mode

PIN DESCRIPTION

1 RB Range resistor B
2 RB Range resistor B
3 I1 Input 1
4 RA Range resistor A
5 VN Negative supply
6 CAZ Autozero capacitor
7 CAZ Autozero capacitor
8 GND Ground
9 CF/ZC OUT Digital output
10 CF/ZC SEL Digital output select
11 PROT Input protection clamp
12 CRMS Integrating capacitor
13 IOUT Current output
14 VP Positive supply
15 RNG SEL Range selection
16 ENA Enable input
17 12 Input 2
18 RA Range resistor A

3.7.12 Linear LTC1052 chopper-stabilized operational amplifier

DESCRIPTION

The LTC1052 are low noise chopper-stabilized opamps manufactured using Linear Technology's enhanced LTCMOS™ silicon gate process. Chopper-stabilization constantly corrects offset voltage errors. Both initial offset and changes in the offset due to time, temperature and common-mode voltage are corrected. This, coupled with picoampere input currents, gives these amplifiers unmatched performance.

Low frequency (1/f) noise is also improved by the chopping technique. Instead of increasing continuously at a 3dB/octave rate, the internal chopping causes noise to decrease at low frequencies.

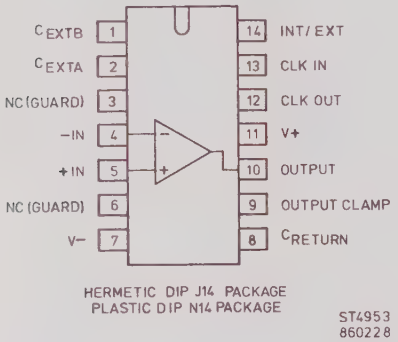


Figure 3.28 Pin connections

4. DISMANTLING THE INSTRUMENT

GENERAL INFORMATION

This section provides the dismantling procedures required for the removal of components during repair operations. All circuit boards removed from the instrument must be adequately protected against damage, and all normal precautions regarding the use of tools must be observed. During dismantling a careful note must be made of all disconnected leads so that they can be reconnected to their correct terminals during re-assembly.

CAUTION: Damage may result if:
- the instrument is switched on when a circuit board has been removed.
- a circuit board is removed within one minute after switching-off the instrument.

Disconnect measuring terminals before opening.

4.1 REMOVING THE COVER (Figure 4.1)

- Remove the fixing screws (rear and bottom of the instrument)
- Pull the cover back from the front
- Remove the plastic connecting rails

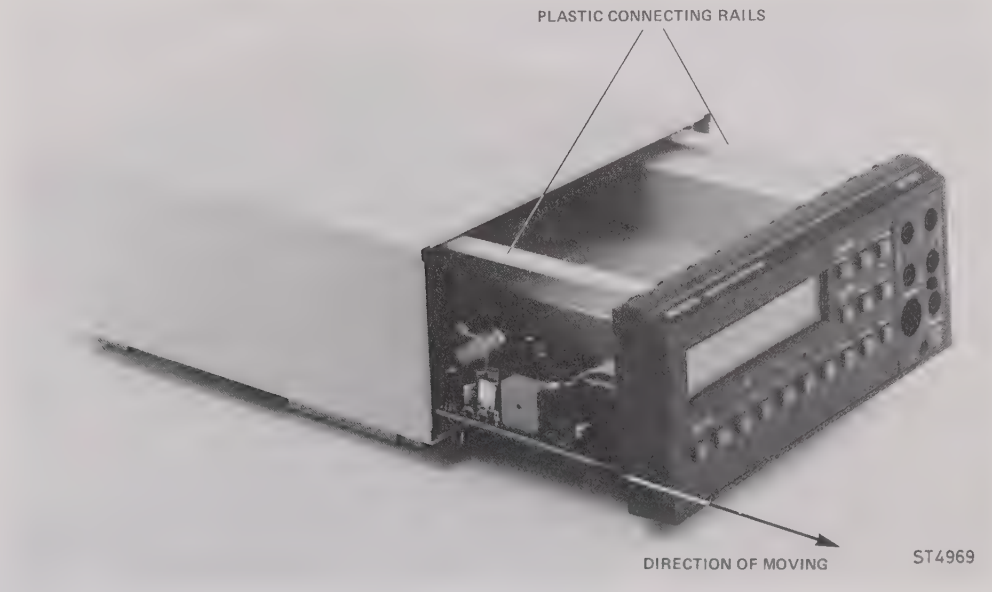


Figure 4.1

4.2 REMOVING THE TOP SCREENING (Printed circuit board, component side)

- Remove the cover
- Remove the two fixing screws of the screening (bottom)
- Push the screening in the direction of the front (figure 4.2 arrow 1)
- Lift up the screening (figure 4.2 arrow 2)

4.3 REMOVING THE BOTTOM SCREENING (Printed circuit board, conductor side)

- Place the instrument upside down
- Push screening in the direction of the rear (figure 4.2 arrow 3)
- Lift up screening (figure 4.2 arrow 4)

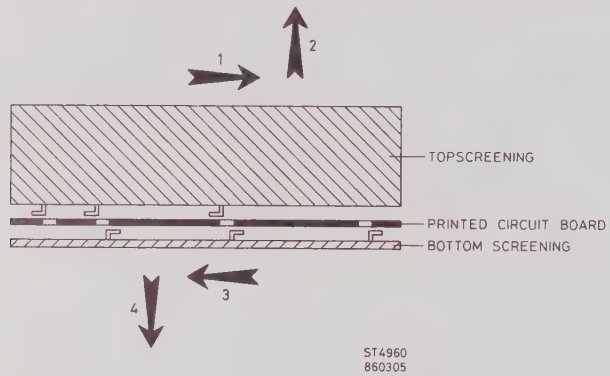


Figure 4.2

4.4 REMOVING THE FRONT ASSEMBLY

- Remove the cover
- Remove the screening
- Disconnect the front assembly from the motherboard (by connector X2101)
- Bend out the two hooks of the front assembly at the component side of the printed circuit board (figure 4.3)
- Pull back the front assembly

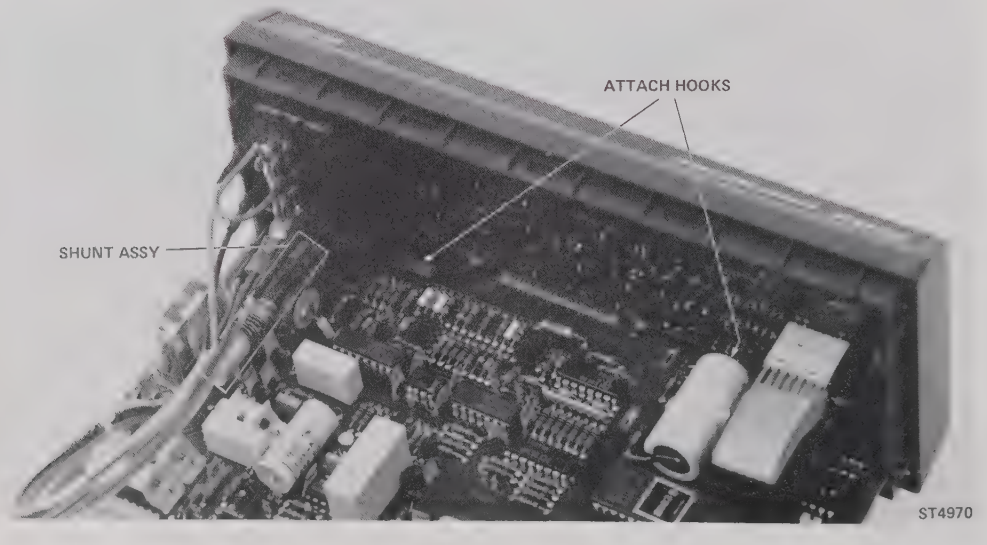


Figure 4.3

5. CHECKING AND ADJUSTING

5.1 GENERAL INFORMATION

The following information provides the complete checking and adjusting procedures for the instrument. As various control functions are interdependent, a certain order of adjustment is necessary. The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature.

- Warming-up time under average conditions is 30 minutes.
- Where possible, instrument performance should be checked before any adjustment is made.
- All limits and tolerances given in this Section are calibration guides, and should not be interpreted as instrument specifications unless they are also published in the operating manual of this instrument.
- Tolerances given are for the instrument under test and do not include test equipment error.
- All controls which are mentioned without item numbers are located on the outside of the instrument.

5.2 CALIBRATION

Via the CAL switch (pencil operation) the electronic calibration mode is entered. While pressing the CAL switch, the RESET switch must be pressed. Release the RESET switch before releasing the CAL switch.
In the calibration enable mode is entered now the instrument is normally measuring. To calibrate a function with a certain range, the CHECK key must be pressed. Select with the function keys the desired function and with the UP and DOWN knobs, the range.
After supplying the signal to the input terminals, push SINGLE trigger to calibrate.
To calibrate the next range or function select the range and/or function and push SINGLE TRIGGER again. It is also possible to measure normal again. To do this push the END button. The PM2534 is now measuring but stays in the calibration enable mode.
The RESET or POWER ON will disable the calibration enable mode. The following diagram will give an overview.

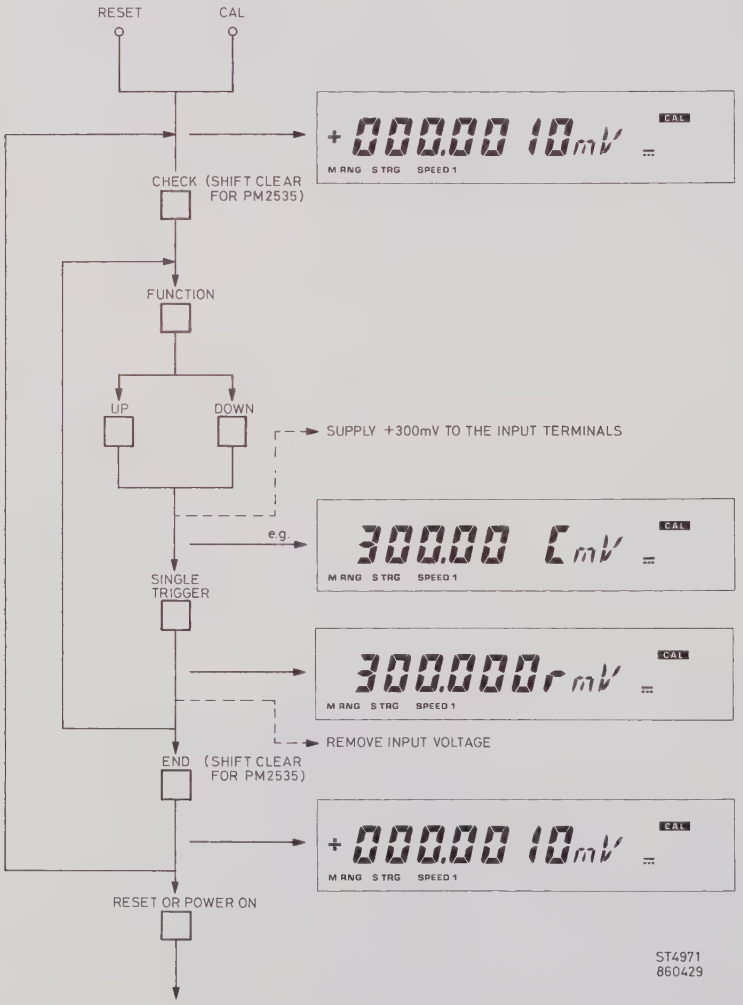


Figure 5.1 Flow-chart

NOTE: For PM2535 the shift clear will disable the calibration enable mode.

The PM2534 responds if the calibration was succesively with a r (ready) at the end of the displayed value.
If the supplied signal is not the correct one or the range cannot be calibrated it responds with FAIL.

The adjusting procedure consists of two parts: A and B.
The first part (A) of the procedure should only be used when components in the referece voltage circuit or the ADC circuit are replaced. In all other cases it is possible to start directly with part B.

NOTE: The accuracy of the input signal, mentioned in the table is 2 times better than the 90 days specification of the PM2534. It is based on a system with the following instruments:

Fluke 5100 Series B calibrator + fluke multimeter 8505A
Valhalla 2724A Programmable resistance standard.

The DC voltage of the Fluke 5100B calibrator is not accurate enough. These voltages must be first measured with a Fluke multimeter 8505A, and adjusted to obtain the correct voltage.

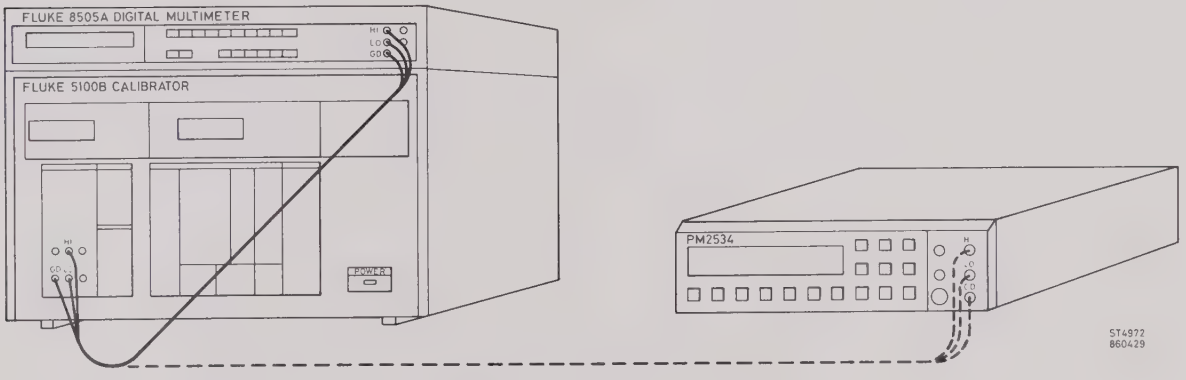


Figure 5.2 Calibration set-up

With the above-mentioned instruments it is not possible to adjust the ± 300 mA DC current (not accurate enough). To adjust these currents a Valhalla 2500 EP programmable AC-DC current calibrator can be used.

PART A

1 If components are replaced in the reference voltage circuit are replaced, the reference voltage must be adjusted again. Proceed as follows:

- Replace the wires across the resistors R1453, R1554, R1455, R1458, R1459 and R1460 if cut.
- Measure the voltage between points P and N with an acurracy which is better than 0.1 %.
- Find, in the table below, the wires which have to be cut.

Uref	1	2	3	4	5	6
10.00	-	-	-	*	*	*
10.20	-	-	*	*	*	-
10.40	-	*	-	*	-	*
10.55	-	*	*	*	-	-
10.70	*	-	-	-	*	*
10.85	*	-	*	-	*	*
11.00	*	*	-	-	-	*
11.15	*	*	*	-	-	-

* means cut the wire

- Measure again the voltage between point P and N. If the voltage is lower than 10.00 volt replace the wires again and choose a value in the table which belongs to a lower value of Uref.

2 If components in the ADC circuit are replaced the dead band zero must be adjusted.

Proceed as follows:

- Set the instrument in function VDC, range 3 V and speed 2.
- Adjust resistor R1424 (MR25, 1 % E96 series) so that the difference between + 0,3 mV and - 0,3 mV on the input, shows 60 dig ± 1 dig on the display.

example: +0,3 V shows 0.00020 mV
-0,3 V shows 0.00040 mV
——————— +
60 dig

No	Adjustment	Preparation	Input signal	Display before calibration	Display after calibration	Remarks
1	Vdc 300 mV					
	zero	Set instrument in: V=, 300mV	Short-circuit the VΩ and 0-socket	300.00 C mV=	+000.000r ±1 dig	Press single trigger
	+300 mV		+300 mV ±0.0032%	300.00 C mV=	+300.000r ±1 dig	Press single trigger
	-300 mV		-300 mV ±0.0032%	300.00 C mV=	-300.000r ±1 dig	Press single trigger
2	Vdc 3 V					
	zero	Set instrument in: V=, 3 V	Short-circuit the VΩ and 0-socket	3.0000 C mV=	+0.00000r ±1 dig	Press single trigger
	+3 V		+3 V ±0.0028%	3.0000 C mV=	+3.00000r ±1 dig	Press single trigger
	-3 V		-3 V ±0.0028%	3.0000 C mV=	-3.00000r ±1 dig	Press single trigger
3	Vdc 30 V					
	zero	Set instrument in: V=, 30 V	Short-circuit the VΩ and 0-socket	30.000 C mV=	+00.0000r ±1 dig	Press single trigger
	+30 V		+30 V ±0.0035%	30.000 C mV=	+30.0000r ±1 dig	Press single trigger
	-30 V		-30 V ±0.0035%	30.000 C mV=	-30.0000r ±1 dig	Press single trigger
4	Vdc 300 V					
	zero	Set instrument in: V=, 300 V	Short-circuit the VΩ and 0-socket	300.00 C mV=	+000.000r ±1 dig	Press single trigger
	+300 V		+300 V ±0.0035%	300.00 C mV=	+300.000r ±1 dig	Press single trigger
	-300 V		-300 V ±0.0035%	300.00 C mV=	-300.000r ±1 dig	Press single trigger
5	Vac 300 mV					
	300 mV 400 Hz	Set instrument in: V~, 300mV	300 mV ±0.1%	300.00 C mV~	300.00 r ±1 dig	Press single trigger

6	Vac 3 V 3 V 400 Hz	Set instrument in: V~, 3 V	3 V ±0.085%	3.0000 C mV~	3.0000 r ±1 dig	Press single trigger
7	Vac 30 V 30 V 400 Hz	Set instrument in: V~, 30 V	30 V ±0.083%	30.000 C mV~	30.000 r ±1 dig	Press single trigger
8	Vac 300 V 300 V 400 Hz	Set instrument in: V~, 300 V	300 V ±0.068%	300.00 C mV~	300.00 r ±1 dig	Press single trigger
9	Ohm 2-wire pre cal open input 30 MΩ	Select: Ohm	Short-circuit VΩ and 0-socket Open input 30 MΩ ±0.05%	00.00 PC MΩ OP.EN PC MΩ 30.000 PC MΩ	OP.EN PC MΩ 30.00 PC MΩ 30.000 C MΩ	Press single trigger Press single triggre Press single trigger
10	Ohm 2-wire zero 3 kΩ	Set instrument in: Ω-2w, 3 kΩ	Short-circuit the VΩ and 0-socket +3 kΩ ±0.001%	3.0000 C kΩ 3.0000 C kΩ	+0.00000r ±1 dig +3.00000r ±1 dig	Press single trigger Press single trigger
11	Ohm 2-wire zero 30 kΩ	Set instrument in: Ω-2w, 30 kΩ	Short-circuit the VΩ and 0-socket +30 kΩ ±0.001%	30.000 C kΩ 30.000 C kΩ	+00.0000r ±1 dig +30.0000r ±1 dig	Press single trigger Press single trigger
12	Ohm 2-wire zero 300 kΩ	Set instrument in: Ω-2w, 300 kΩ	Short-circuit the VΩ and 0-socket +300 kΩ ±0.001%	300.00 C kΩ 300.00 C kΩ	+000.000r ±1 dig +300.000r ±1 dig	Press single trigger Press single trigger

13	Ohm 2-wire zero 3 MΩ	Set instrument in: Ω-2w, 3 MΩ press check	Short-circuit the VΩ and 0-socket +3 MΩ ±0.02%	3.0000 C kΩ 3.0000 C MΩ	+0.00000r ±1 dig +3.00000r ±1 dig	Press single trigger Press single trigger
14	Ohm 2-wire zero 30 MΩ	Set instrument in: Ω-2w, 30 MΩ	Short-circuit the VΩ and 0-socket +30 MΩ ±0.05%	30.000 C kΩ 30.000 C MΩ	+00.0000r ±1 dig +30.0000r ±1 dig	Press single trigger Press single trigger
15	Ohm 2-wire zero 300 MΩ	Set instrument in: Ω-2w, 300 MΩ	Short-circuit the VΩ and 0-socket +3 MΩ ±0.8%	300.00 C kΩ 300.00 C MΩ	+000.000r ±1 dig +300.000r ±1 dig	Press single trigger Press single trigger
16	Ohm 4-wire zero 3 kΩ	Set instrument in: Ω-4w, 3 kΩ	Short-circuit the VΩ and 0-socket +3 kΩ ±0.01%	3.0000 C kΩ 3.0000 C kΩ	+0.00000r ±1 dig +3.00000r ±1 dig	Press single trigger Press sigle trigger
17	Ohm 4-wire zero 30 kΩ	Set instrument in: Ω-4w, 30 kΩ	Short-circuit the VΩ and 0-socket +30 kΩ ±0.01%	30.000 C kΩ 30.000 C kΩ	+00.0000r ±1 dig +30.0000r ±1 dig	Press single trigger Press single trigger
18	Ohm 4-wire zero 300 kΩ	Set instrument in: Ω-4w, 300 kΩ	Short-circuit the VΩ and 0-socket +300 kΩ ±0.01%	300.00 C kΩ 300.00 C kΩ	+000.000r ±1 dig +300.000r ±1 dig	Press single trigger Press single trigger

19	Ohm 4-wire					
	zero	Set instrument in: Ω-4w, 3 MΩ	Short-circuit the VΩ and O-socket	3.0000 C kΩ	+0.00000r ±1 dig	Press single trigger
	3 MΩ	press check	+3 MΩ ±0.02%	3.0000 C MΩ	+3.00000r ±1 dig	Press single trigger
20	Adc 30 mA					
	zero	Set instrument in: A=, 30 mA	Open input	30.000 C mA=	+00.0000r ±1 dig	Press single trigger
	+30 mA		+30 mA ±0.016%	30.000 C mA=	+30.0000r ±1 dig	Press single trigger
	-30 mA		-30 mA ±0.016%	30.000 C mA=	-30.0000r ±1 dig	Press single trigger
21	Adc 3 A					
	zero	Set instrument in: A=, 3 A	Open input	2.0000 C mA~	+0.00000r ±1 dig	Press single trigger
	+2 A		+2 A ±0.0275%	2.0000 C mA~	+2.00000r ±1 dig	Press single trigger
	-2 A		-2 A ±0.0275%	2.0000 C mA~	-2.00000r ±1 dig	Press single trigger
22	Aac 300 mA					
	300 mA 400 Hz	Set instrument in: A~, 300 mA	300 mA ±0.137%	300.00 C mA	300.000r ±1 dig	Press single trigger
23	Aac 3 A					
	2 A 400 Hz	Set instrument in: A~, 3 A	2 A ±0.08%	2.0000 C mA	2.00000r ±1 dig	Press single trigger

5.3 ADJUSTING THE PM2534/PM2535 WITH THE AID OF A CONTROLLER

The calibration mode can be called via the IEC/IEEE-bus.
To use this feature, a program string must be sent to the PM2534/PM2535. First the calibration enable mode must be entered. (Press the CAL and RESET switch and release the RESET switch before releasing the CAL switch).
Via the command CAL␣ON the calibration mode is enabled.
To calibrate a function with a range, select via the commands described in the operating manual, the function and range. The calibration can be started by sending a trigger command "X1" or "GET". After the calibration is finished the next function/range can be selected. The calibration mode is left by sending CAL␣OFF to the instrument. By this the calibration enable mode is entered again.

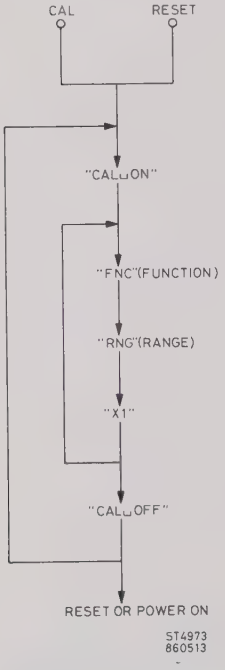


Figure 5.3 Flow-chart

Example with P2000C controller (cal enable mode entered!)

```
10 IEC INIT
20 IEC PRINT #22, "CAL␣ON"    .: cal-mode enabled
30 IEC PRINT #22, "FNC␣VDC"    : function volt DC
40 IEC PRINT #22, "RNG 30"     : range 30 volt
50 IEC PRINT #22, "X1"         : trigger
60 IEC PRINT #22, "CAL␣OFF"    : cal enable mode entered
70 IEC END
```

6. CORRECTIVE MAINTENANCE

6.1 SPECIAL PARTS

In addition to the standard electronic components, some special components are used:
- Components, manufactured or selected by Philips to meet specific performance requirements.
- Components which are important for the safety of the instrument.

ATTENTION: Both type of components may only be replaced by components obtained through your local Philips organisation or representative. These components have been marked in the Parts List by a *.

6.2 REPLACING PARTS

NOTE: SWITCH OFF MAINS BEFORE REMOVING PARTS.

6.2.1 Parts on the PCB

- Dismantle PM2534 (refer to section 4.1)
- Remove screening

6.2.2 LX- display, window and interconnection rubber

- Dismantle PM2534 (refer to section 4.1)
- Remove screening (refer to section 4.2)
- Remove front assembly (refer to section 4.4)
- Bend out the six hooks and lift the PCB out of the front assembly (figure 6.1)
- Push the attach hooks out of the holes at the component side of the PCB and lift the LCD display from the PCB (see figure 6.2).

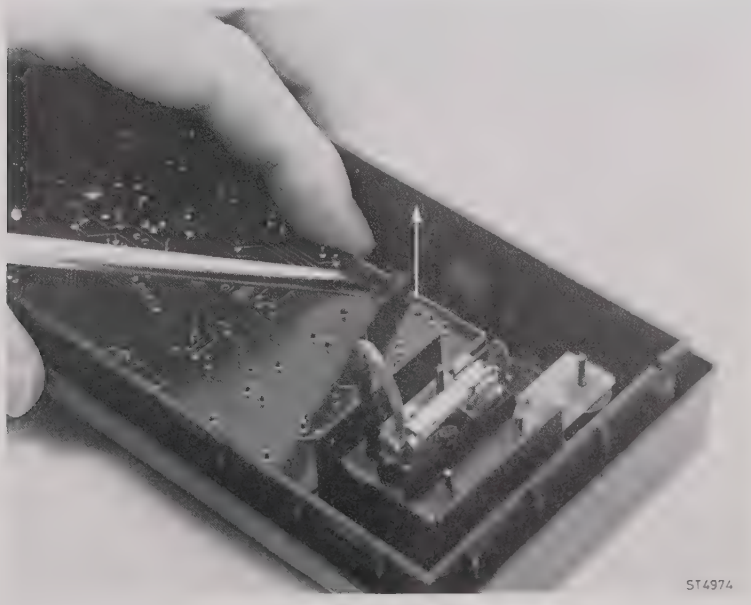


Figure 6.1

The assembly of the display consists of four main parts (figure 6.2). All parts can be replaced seperately.

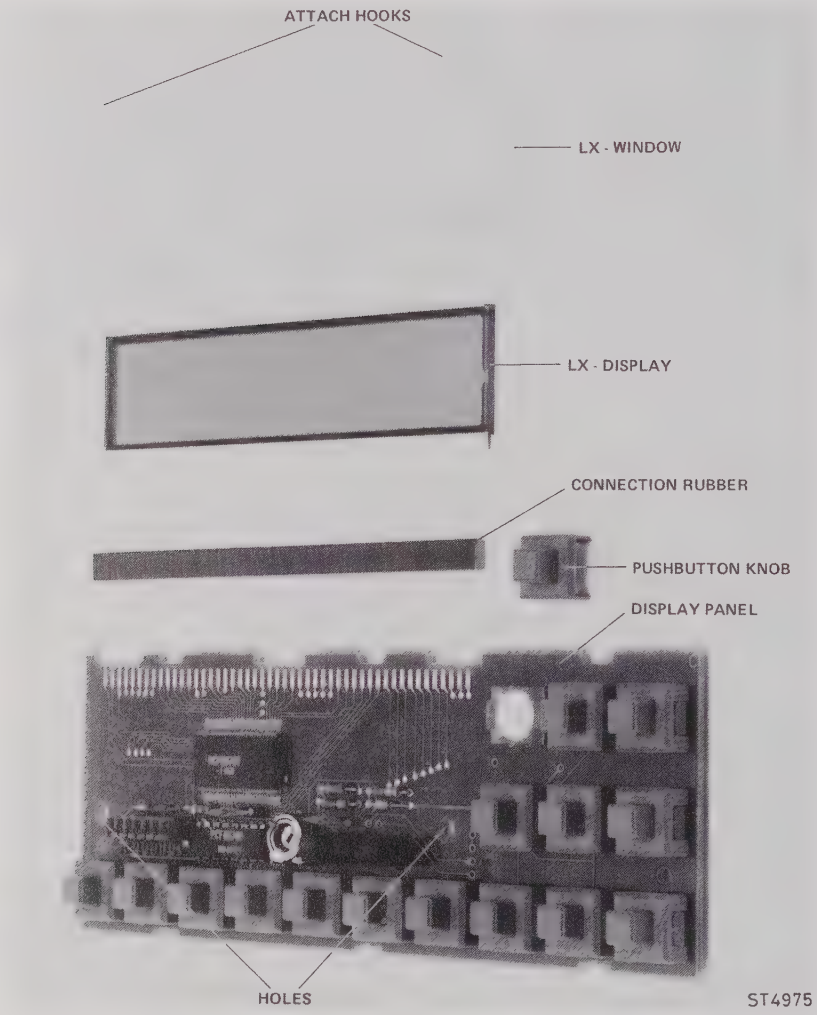


Figure 6.2

6.2.3 Input unit

- Dismantle the PM2534 (refer to section 4.1).
- Remove the screening (refer to section 4.2).
- Remove the fixing screw (figure 6.3).
- Pull out the input from the front assembly.
- Remove the wires from the input unit.
- Remove fixing screw in the fuseholder.
- Desolder the two wires of the switch.
- Lift-up PCB.
- Take care of the contact springs (ZERO and GUARD).
- Demount switch by using a pair of tweezers (be careful not to break the plastic mounting pins).

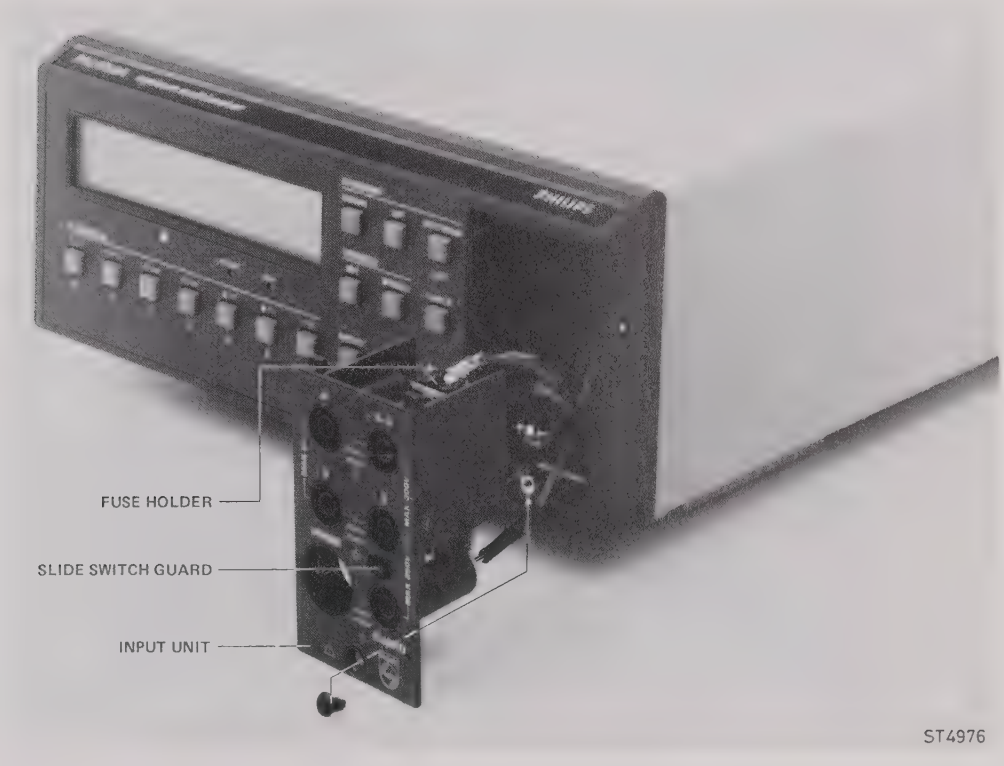


Figure 6.3

6.2.4 Interchanging input unit (figure 6.4)

- It is possible to mount the input unit at the rear, often used in system configuration.

To do this proceed as follows:
- Dismantle PM2534
- Remove screening
- Remove fixing screws (front and rear) from the input unit front and the coverplate (rear)
- Pull the input unit out of the front assembly
- Remove the wires from the input unit
- Remove coverplate at the rear
- Place coverplate in front assembly
- Connect the input cables and place the input unit in the rear

Tp 1010	RED = VΩ
Tp 1009	BLACK = 0 (V)
Tp 1006	BLEU = guard
Tp 1007	BROWN = A
Tp 1008	GREY = 0 (A)

- Screw coverplate and input unit to the instrument

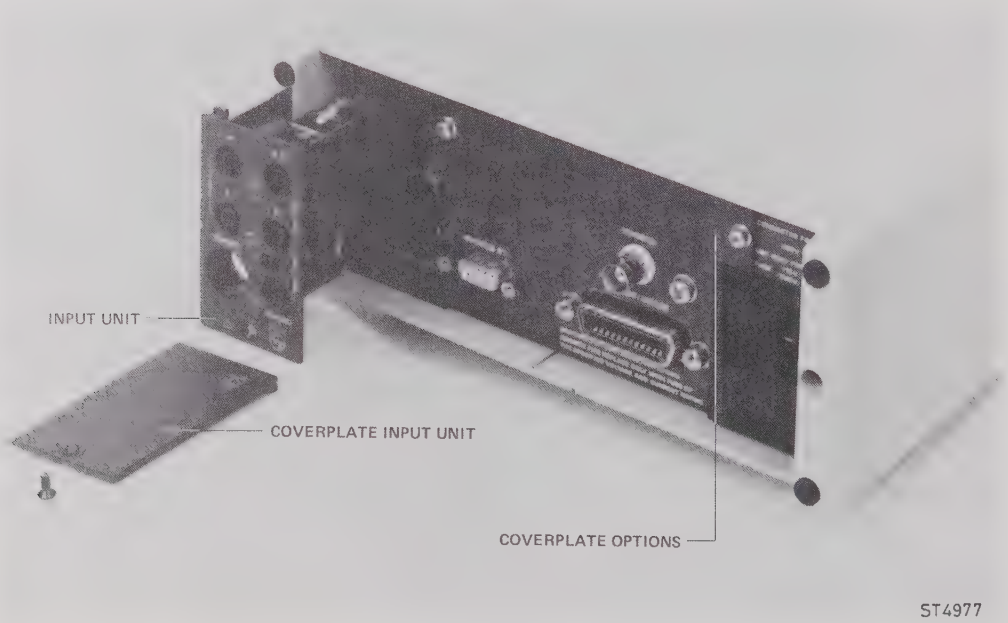


Figure 6.4

6.2.5 Fuses

Change fuse on the input unit
- Remove fixing screw in the input unit
- Pull the input unit out of the frontassembly
- Replace fuse F1102 3,15A Fast blow

Change fuse F1901 on the motherboard (SYST 21)
- Dismantle PM2534
- Replace fuse F1901 200 mA Slow blow

6.3 TROUBLESHOOTING

The troubleshooting can be subdivided into two parts.

A: Normal measurements

For normal measurements (with multimeter and scope) the testpoints on the printed circuit board can be used.
In this part a diagram with places of the testpoints is given, and an overview with wave forms and voltages on these testpoints. Also a switching table is added. The testpoint numbers correspond with the numbers given in the overall diagram of the instrument (figures 9.1 and 9.2)

B: Repair by signature analysis with the aid of a testrom.

Repair can be done with the aid of a testrom (ordering code 5322 694 54039). In this testrom, tests are implemented for signature analysis, ADC and display testing.

If self servicing has to be carried out, the following points should be taken in to account in order not to damage the instrument.
- Take care to avoid short-circuiting with measuring clips
- Use a miniature soldering iron (35 W max.)
- Use an acid-free solder
- After repair, the instrument should be calibrated again

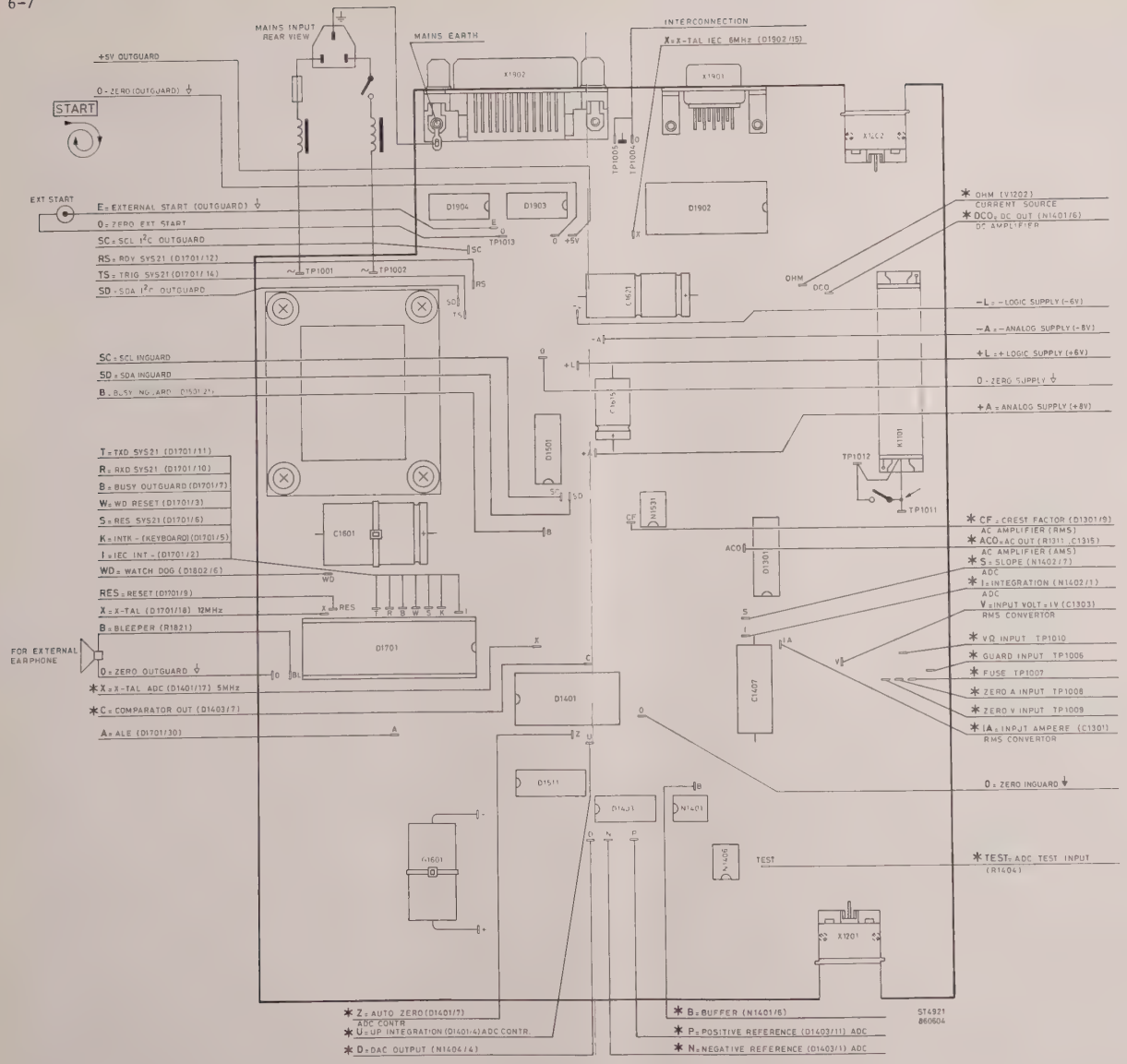
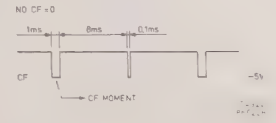
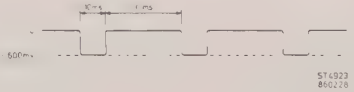

MAINS INPUT REAR VIEW
MAINS EARTH
INTERCONNECTION
X = X-TAL IEC 6MHz (D1902/15)
+5V OUTGUARD
0 - ZERO (OUTGUARD)
START
EXT START
E = EXTERNAL START (OUTGUARD)
0 = ZERO EXT START
SC = SCL I²C OUTGUARD
RS = RDY SYS21 (D1701/12)
TS = TRIG SYS21 (D1701/14)
SD = SDA I²C OUTGUARD
SC = SCL INGUARD
SD = SDA INGUARD
B = BUSY INGUARD (D1501/2)
T = TXD SYS21 (D1701/11)
R = RXD SYS21 (D1701/10)
B = BUSY OUTGUARD (D1701/7)
W = WD RESET (D1701/3)
S = RES SYS21 (D1701/6)
K = INTK - (KEYBOARD) (D1701/5)
I = IEC INT - (D1701/2)
WD = WATCH DOG (D1802/6)
RES = RESET (D1701/9)
X = X-TAL (D1701/18) 12MHz
B = BLEEPER (R1821)
FOR EXTERNAL EARPHONE
0 = ZERO OUTGUARD
X = X-TAL ADC (D1401/17) 5MHz
C = COMPARATOR OUT (D1403/7)
A = ALE (D1701/30)
* OHM (V1202) CURRENT SOURCE
* DCO = DC OUT (N1401/6) DC AMPLIFIER
-L = -LOGIC SUPPLY (-6V)
-A = -ANALOG SUPPLY (-8V)
+L = +LOGIC SUPPLY (+6V)
0 - ZERO SUPPLY
+A = ANALOG SUPPLY (+8V)
* CF = CREST FACTOR (D1301/9) AC AMPLIFIER (RMS)
* ACO = AC OUT (R1311, C1315) AC AMPLIFIER (AMS)
* S = SLOPE (N1402/7) ADC
* I = INTEGRATION (N1402/1) ADC
V = INPUT VOLT = 1V (C1303) RMS CONVERTOR
* VΩ INPUT TP1010
* GUARD INPUT TP1006
* FUSE TP1007
* ZERO A INPUT TP1008
* ZERO V INPUT TP1009
* IA = INPUT AMPERE (C1301) RMS CONVERTOR
0 = ZERO INGUARD
* TEST = ADC TEST INPUT (R1404)
* Z = AUTO ZERO (D1401/7) ADC CONTR
* U = UP INTEGRATION (D1401/4) ADC CONTR.
* D = DAC OUTPUT (N1404/4)
* B = BUFFER (N1401/6)
* P = POSITIVE REFERENCE (D1403/11) ADC
* N = NEGATIVE REFERENCE (D1403/1) ADC
ST4921
860604

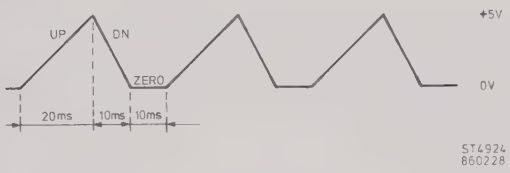
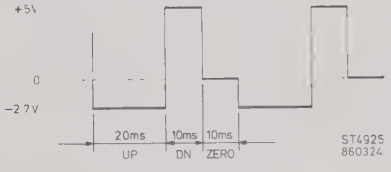
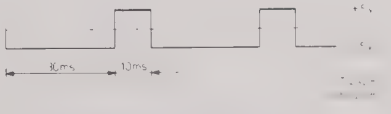
Figure 6.5 TEST PIN LOCATION

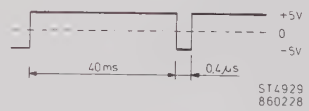
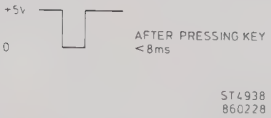
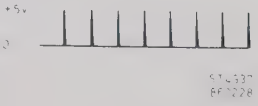
PART A

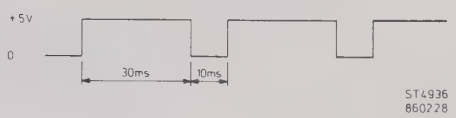
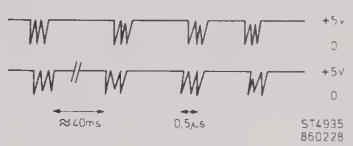
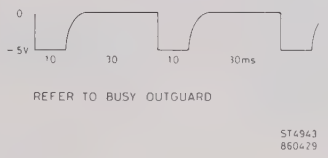
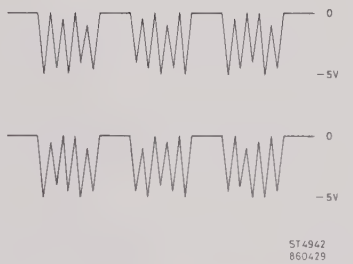
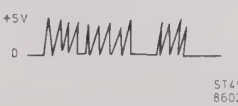
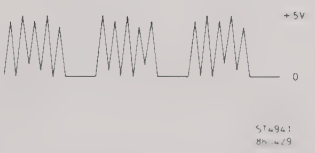
SIGNALS ON TESTPINS (refer to figure 6.5)
* = INGUARD SIGNALS WITH RESPECT TO ZERO INGUARD
(NO) = OUTGUARD SIGNALS WITH RESPECT TO ZERO OUTGUARD

Remark: Take care with earthing in the d.c. functions

	SIGNAL NAME (BEGINS WITH START)	PICTURE
1	X - TAL IEC 6 MHz (D1902/15)	
2	* OHM = Current source (V1202)	DC voltage ≈ -1,5 V 1k input dependent on current
3	* DCO = DCout amplifier (N1101/6)	DC voltage + input = -V - input = +V range end = ≈ 3 V clamp = 5 V
4	-L = -Logic supply +L = +Logic supply -A = -Analog supply +A = +Analog supply 0 = Zero supply	-6 V +6 V -8 V +8 V ⏚
5	* CF = Crest factor AC amplifier AC voltage in ≈ 8 V~	
6	* ACO = AC out a.c. amplifier (R1311/C1315)	DC voltage 0 ⟶ -V Clamp= -3 V
7	* S = slope ADC (N1402/7)	Input = +2,7 V, speed 2  At - input, the signal is reversed

8	* I = Intergration ADC (N1402/1)	Input +2,7 V, speed 2  At - input, the signal is reversed
9	* V = Input volt rms convertor (C1303)	Follows AC input voltage to rms convertor
10	* IA = Input ampère rms convertor (C1301)	AC voltage from shunt to rms convertor
11	* TEST = ADC test input (A1409/R1404)	To set a DC voltage in ADC test mode (to be followed)
12	* B = output Buffer (N1401/6)	Input +2,7 V, speed 2  UP = input connected DN = + ref connected ZERO = zero connected
13	* P = Positive + reference (N1403/11) * N = Negative - reference (N1403/1)	+5 V -5 V
14	* Z = Auto zero (D1401/7) ADC control	
15	* U = Up integration (D1401/4) ADC control	Input +2,7 V, speed 2
16	* D = Dac output (N1404/4)	Input +2,7 V, speed 2

17	A = ALE (D1701/30)	Input +2,7 V, speed 2
18	* C = Comparator output	Input +2,7 V, speed 2 
19	* X = X-TAL ADC 5 MHz (D1401/7)	
20	B = Bleeper O = O bleeper	
21	X = X-TAL up (D1701/18) 12 MHz	
22	RES = Reset (D1701/9)	
23	WD = Watchdog (D1802/6)	
24	I = IEC interrupt (IEC INT-) (D1701/2)	Only when bus instr. is connected
25	K = Interrupt from keyboard (D1701/5) (INTK-)	
26	S = Reset sys 21 (D1701/6)	Logic 1 (+5 V)
27	W = WD Reset (D1701/3) (watch dog)	

28	B = Busy outguard (D1701/7)	Input +2,7 V, speed 2 
29	T = transmit sys 21 (D1701/11) R = receive sys 21 (D1701/10)	
30	B = Busy inguard	
31	SC = SCL I^2C inguard SD = SDA I^2C inguard	
32	SD = SDA I^2C outguard	
33	TS = Trigger sys 21 (D1701/14)	Logic 1
34	RS = Ready sys 21 (D1701/12)	Logic 1
35	SC = SCL I^2C outguard	
36	E = External Start (Outguard) 0 = Zero	Refer to specification Signal "EXINT-"

Built-in tests

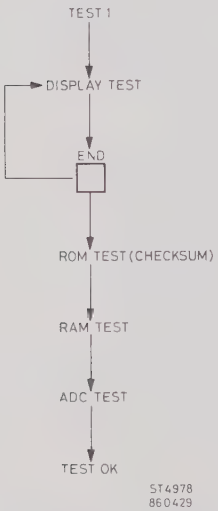
The ROM, RAM and display of the PM2534 and PM2535 can be tested by the standard software of the instrument. These tests only indicate a failure (FAIL on display); they do not locate the faulty component.

To activate the PM2534 test proceed as follows:

- Push 4 times the "CHECK" switch.
- Push the "1" switch.
- Push the "END" switch.

To activate the PM2535 test proceed as follows:

- Push the "SHIFT" switch.
- Push the "CHECK" switch.
- Push 3 times the "ENTER" switch.
- Push the "1" switch.
- Push the "ENTER" switch.



Visual test (see figures 6.7 and 6.8).

If "END" is pushed continuously the instrument stays in the display test (or "ENTER" for PM2534).

"ERROR 2" on display in case of an error.

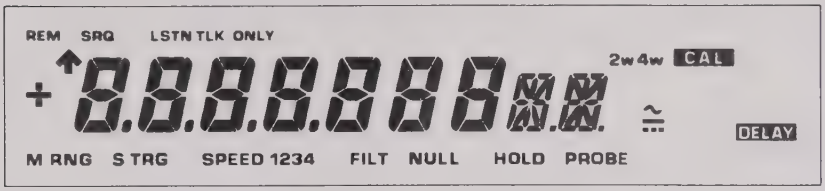
"ERROR 3" on display in case of an error.

"ERROR 4" on display in case of an error.

"TEST ok" on display.

Figure 6.6 Built-in tests

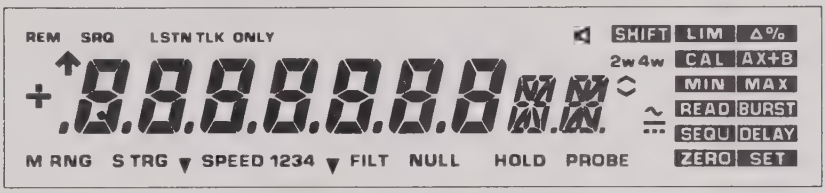
In the display test of the PM2534, the following is on the display:



ST4979

Figure 6.7 PM2534 display

For the PM2535 the following is on the display in the test.



ST4980

Figure 6.8 PM235 display

Relay/FET table

		D1513					D1512						D1401			
	Function	01	02	03	04	05	R1	R2	R3	R5	R6	R7	OA	OB	OC	OD
V ⎓	300 mV	0	0	0	1	0	0	0	0	0	0	0	*	*	0	1
	3 V	0	0	1	1	0	0	0	0	0	0	0	*	*	0	0
	30 V	0	0	0	0	0	1	0	0	0	0	0	*	*	0	1
	300 V	0	0	1	0	0	1	0	0	0	0	0	*	*	0	0
V~	300 mV	0	1	0	0	0	0	0	0	*	0	0	0	0	1	0
	3 V	0	1	0	0	0	0	0	0	*	1	0	0	0	1	0
	30 V	0	1	0	0	0	0	0	0	*	0	1	0	0	1	0
	300 V	0	1	0	0	0	0	0	0	*	1	1	0	0	1	0
Ω -2W	3 kΩ	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0
	30 kΩ	1	0	1	1	0	0	0	0	1	0	1	0	0	0	0
	300 kΩ	1	0	1	1	0	0	0	0	0	1	0	0	0	0	0
	3 MΩ	1	0	1	1	0	0	0	0	0	1	1	0	0	0	0
	30 MΩ	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0
	300 MΩ	1	0	1	1	0	0	0	0	0	0	1	0	0	0	0
Ω -4W	3 kΩ	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0
	30 kΩ	0	0	0	0	0	0	0	1	1	0	1	1	1	0	0
	300 kΩ	0	0	0	0	0	0	0	1	0	1	0	1	1	0	0
	3 MΩ	0	0	0	0	0	0	0	1	0	1	1	1	1	0	0
A ⎓	30 mA	0	0	0	0	1	0	1	0	0	0	0	*	*	0	1
	3 A	0	0	0	0	0	0	1	0	0	0	0	*	*	0	1
A~	30 mA	0	0	0	0	1	0	0	0	*	0	0	0	0	1	0
	3 A	0	0	0	0	0	0	0	0	*	0	0	0	0	1	0
°C	-100-850°C	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0

* Depends on filter { filter on : * = 1 / filter off: * = 0 } * Depends on measuring speed

PART B Tests with Signature Analysis and Testrom

Brief description of Signature Analysis.

1. General

For repair by signature analysis a testrom has been developed. This testrom enables the user to test the digital part of the PM2534 by means of Signature Analysis.
Troubleshooting is now possible to component level by a circuit under test, by comparing the actual signature with the correct one.
In total there are 10 tests. In the testrom, 9 tests have been implemented and one test is made with the free-run facility of the PM2534.

2. Why use a Signature Analyser?

When using a microcomputer, the bus structure is very complex. In case of a failure, it cannot be analysed with an oscilloscope or voltmeter. The signature analyser can be used now. Finding faults in a difficult bus system can best be done by opening the feedback part, and then it will become easy.

Brief description of the tests.

Free-run test:

With this test it is possible to measure signatures on the address latches and the databus of the processor. This is necessary to check if the data can be taken from the testrom.

Test 0 (digital part and galvanic separation).
This test checks the I/O parts and the galvanic separation between inguard and outguard.

Test 1 (I^2C bus and switch decoding)
In this test the I^2C lines are checked. Also the decoding of the switches on the display pcb are tested.

Test 2 - Test 4 (ADC)
These tests are for testing the ADC. A voltage (depends on which test) on the input of the ADC is present. In the ADC circuit the various voltages can be measured.

Test 5 - Test 9
With these tests the display is tested. A short-circuit between two segments, backplanes etc. can be seen on the display.

Free-run test

- Remove jumper S1702
- Signals with a * seem to be logic 0 or logic 1 but still show activity (blinking LED)
- Reference: logic 0 = 0000
  logic 1 = 0003

Setting signature analyser

Setting	Edge/Mode	Connections	Test point	Signal name
start		start	D1701 pin 28	AD 15
stop		stop	D1701 pin 28	AD 15
clock		clock	D1701 pin 29	program store enable
ground		ground	0	0

NAME	LOCATION	
ADDRESS BUS	D1701	SIGNATURES
A 0	pin 39	UUUU
A 1	pin 38	FFFF
A 2	pin 37	8484
A 3	pin 36	P763
A 4	pin 35	1U5P
A 5	pin 34	0356
A 6	pin 33	4759
A 7	pin 32	6F9A
A 8	pin 21	7791
A 9	pin 22	6321
A 10	pin 23	37C5
A 11	pin 24	6U28
A 12	pin 25	4FCA
A 13	pin 26	4868
A 14	pin 27	94P1
A 15	pin 28	0002

For measuring signatures on the data bus the clock must be connected to ALE (D1701 pin 30). On the signature analyser the falling edge of the clock must be selected.

Setting	Edge mode	Connections	Testpoint	Signal name
clock		clock	A	ALE

SIGNATURES ON THE DATA BUS

DATABUS	D1701	SIGNATURES
D 0	pin 39	UUUU
D 1	pin 38	FFFF
D 2	pin 37	8484
D 3	pin 36	P763
D 4	pin 35	1U5P
D 5	pin 34	0356
D 6	pin 33	4759
D 7	pin 32	6F9A

If a PM2544 signature analyser is used, the following can also be measured.

Frequencies { D1701 pin 18 and 19, 12 MHz
D1701 pin 29 and 30, 2 MHz

Time measurements

Settings PM2544	
Start Stop	Connect start and stop to $\overline{\text{EXINT}}$

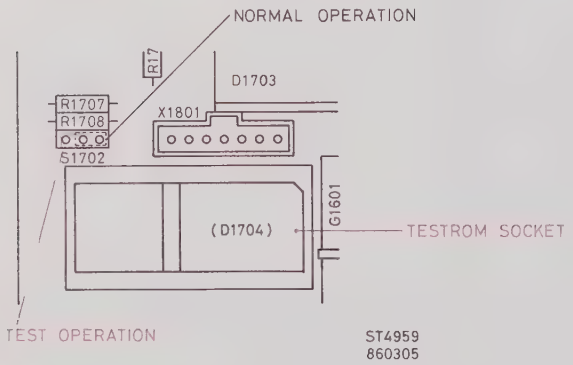
Short-circuit the EXT TRIG input to earth.
The time measured must be between 40-150 µs.

Settings PM2544	
Start Stop	Connect start and stop to WD

Short-circuit test pin W to earth.
The time measured must be between 200-600 msec.

Test 0

- Switch off the POWER
- Place the ROM in the test rom socket (D1704)
- Place the jumper as shown in the figure:



- Connect the anode of V1703 to test pin 0
- Connect test pin -L (inguard) with 0 (zero outguard)

Switch on the PM2534 and measure the following signatures.

- Signals with a * seem to be logic 0 or 1 but still show activity (blinking LED)
- Reference: logic 0 = 0000
  logic 1 = 82CP

Setting signature analyser

Setting	Edge/Mode	Connections	Testpoint	Signal name
Start/stop		Start/stop	RS	RDY SYS
Clock		Clock	A	ALE
Qualifier		Qualifier	TS	TRI SYS
Ground		Ground	0	0

D1701 pin	SIGNATURE
1	82CP*
2	0000
3	FFAP
4	AU4A
5	PA0F
6	PPA8
7	0000
8	H9A5
9	0000
10	282P
11	4578
12	82CP*
13	3383
14	82CP*
15	0439
16	6573
17	8240
18	82CP
19	0000
20	0000
21	82CP
22	82CP
23	0000
29	82CP
31	0000
33	82CP
34	458A
35	C334
36	U6CP
37	39C2
38	72AH
39	6UPP
40	82CP

→ Signature on test pin SD (inguard and outguard)

→ Signature on test pin SC (inguard and outguard)

IC D1401		IC D1401	
Pin	Signature	Pin	Signature
1	CCAA	15	CCAA
4	0000	16	CCAA
5	0000	17	Unstable
6	0000	18	CCAA
7	CCAA	19	0000
8	7743	20	Unstable
9	C96F	21	0000
10	FAP1	22	CCAA
11	C631	23	CCAA
12	0000	24	CCAA

The next signatures must be measured on test pin S (outguard). If an IC, connected with the I^2C bus, is receiving data, it sends back an acknowledge. If no acknowledge is received from that I^2C, the signature on pin 5 changes.

All I^2C integrated circuits ok, signature: 0462

The following signatures can be measured on pin S if the devices mentioned in the table not sending acknowledge:

IC´s not sending acknowledge	SIGNATURES
ALL IC´s OK	0462
D1404	781H
D1511	067U
D1512	APC9
D1513	1H56
D1902	C8P9
D2101	P02C
D2201	31C4

Test 1 (I^2C devices)

- Select test 1 with S1701 (test 1 on display)
- Reference: logic 0 0000
  logic 1 CCAA
- The anode of V1703 must be connected to test pin 0
- Test pin -L (inguard) must be connected 0 (zero outguard)

Setting signature analyser

Setting	Edge/Mode	Connections	Testpoint	Signal name
Start/stop		Start/stop	RS	RDY SYS
Clock		Clock	A	ALE
Qualifier		Qualifier	TS	TRI SYS
Ground		Ground	0	0

IC D1511		IC D1512		IC D1513	
Pin	Signatures	Pin	Signatures	Pin	Signatures
1	0000	1	CCAA	1	0000
2	CCAA	2	0000	2	CCAA
3	CCAA	3	CCAA	3	8999
4	F7C7	4	P3C9	4	Unstable
5	2P1P	5	CA9A	5	4P43
6	A3C1	6	999F	6	9P08
7	133P	7	1CA0	7	FFPF
8	0000	8	0000		
9	5C47	9	6AH0		
10	2299	10	641F		
11	F6F1	11	1AA2		
12	5H93	12	74HC		
13	CCAA	13	0000		
16	CCAA	16	CCAA		

- Pushing a switch on the front will also give a different signature on PIN S (outguard).

PUSHBUTTON	SIGNATURE
0	92P4
1	A365
2	9HUF
3	6AU5
4	O8PP
5	C479
6	F683
7	OP92
8	176U
9	PUC7
INT	H4F9
SINGLE	8595
CHECK	6817
DOWN	628U
UP	7UA7
AUT/MAN	485H

The following signatures can be measured on the I/O expander D2201 (display pcb).

IC D2201			
Pin	Signature	Pin	Signature
1	CAAA	9	0000
2	-	10	C607
3	-	11	1022
4	CAAA	12	2U3U
5	OAC2	13	3203
6	C1F7	14	CCAA
7	P8FH	15	0000
8	2656	16	0000

Test 2, 3 and 4

Tests 2, Test 3 and Test 4 are in principle the same tests, they test the ADC with different voltages on the input.

Voltage on pin 3 of D1402 in TEST 2 = -3 V
Voltage on pin 3 of D1402 in TEST 3 = +0,6 V
Voltage on pin 3 of D1402 in TEST 4 = 0 V

- Test 2 signals

Test 2 can be selected with S1701 (Test 2 on display)

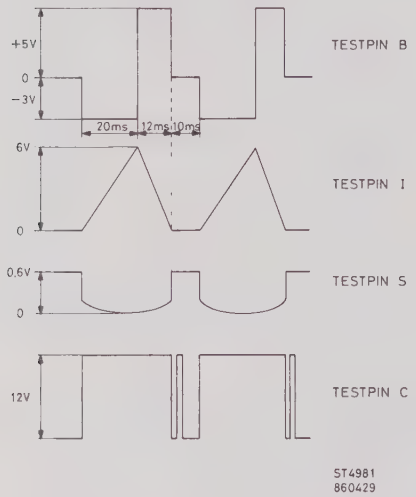


Figure 6.9 Test 2 signals

- Test 3 signals

Test 3 can be selected with S1701 (Test 3 on display)

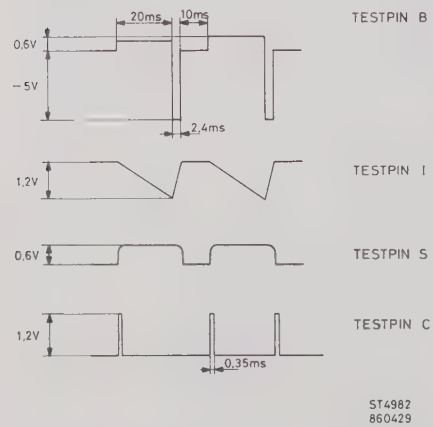


Figure 6.10 Test 3 signals

- Test 4 signals

Test 4 can be selected with S1701 (Test 4 on display)

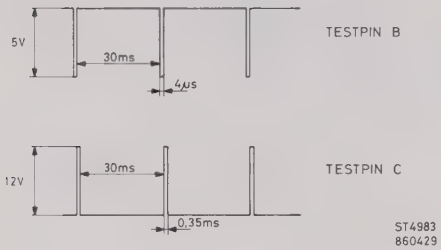


Figure 6.11 Test 4 signals

Test 5-9

Test 5 - Test 9 are for testing the display (visual), they can be selected with S1701.

- Test 5

In test 5 all segments are on.

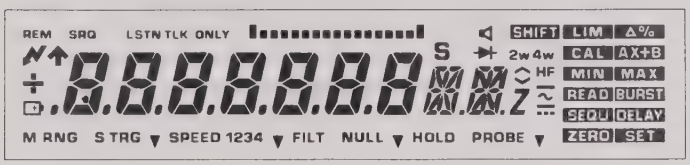


Figure 6.12 Test 5 signals

Test 6

In this test all even segments (S_0, S_2, S_4 - etc.) are on.

Figure 6.13 Test 6 signals

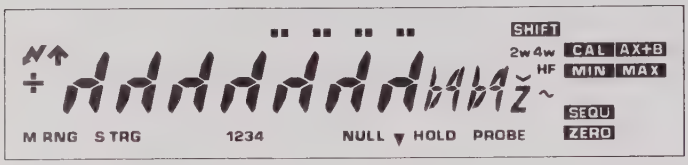
Test 7

In this test all odd segments (S_1, S_3, S_5, etc.) are on.

Figure 6.14 Test 7 signals

Test 8

All segments from backplanes 1 and 3 are on.

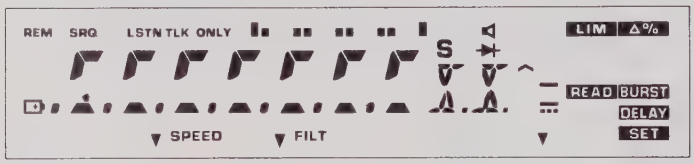


ST4965

Figure 6.15 Test 8 signals

Test 9

All segments from the backplanes 0 and 2 are on.



ST4966

Figure 6.16 Test 9 signals

7. SAFETY INSPECTION TESTS AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT

7.1 GENERAL DIRECTIVES

- Take care that the creepage distance and clearances have not been reduced.
- Before soldering, the wires should be bent through the holes of solder tags, or wrapped around the tag in the form of an open U, or Wiring ridigity shall be maintained by cable clamps or cable lacing.
- Replace all insulating guards and plates.

7.2 SAFETY COMPONENTS

Components in the primary circuit may only be replaced by components selected by Philips, see also 8.

7.3 CHECKING THE PROTECTIVE EARTH CONNECTION

The correct connection and condition is checked by visual control and by measuring the resistance between the protective lead connection at the plug and the cabinet/frame. The resistance shall not be more than 0,5 Ohm. During measurements the mains cable should be removed. Resistance variations indicate a defect.

7.4 ADAPTATION TO THE LOCAL MAINS

For adaptation to the local mains the wiring positioned under the mains transformer must be altered.
Proceed as follows:
- Remove the cover
- Change the drawing as shown in figure 7.1 (230 V, 1 connection; 115 V, 2 connections).

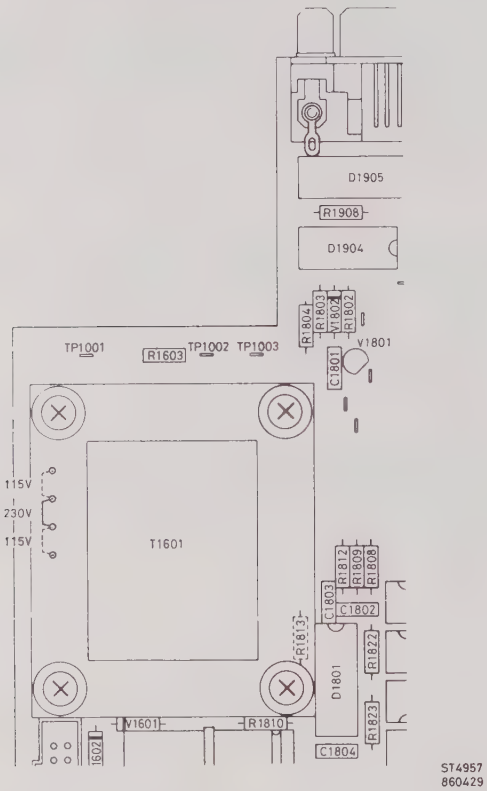


Figure 7.1 Adaption to the local mains

7.5 ADAPTATION TO THE LOCAL MAINS FREQUENCY

For adaptation to 60 Hz the 5 MHz X-tal (G1401) must be changed for a 6 MHz X-tal (codenr. 5322 242 74364). Also a new adjustment must be made for the ADC (refer to Chapter 5).

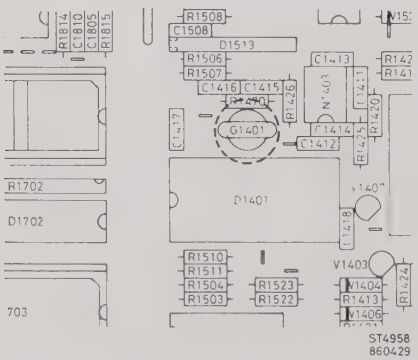


Figure 7.2

8. PARTS LIST

WARNING: components marked with a *, may only be replaced by components obtained through your local Philips organisation or representative.

8.1 MECHANICAL PARTS

Description	Ordering no.	Figure
L.C.D.	5322 130 90279	6.2
Pushbutton knob all functions	5322 414 20031	6.2
Pushbutton knob PM2535 SHIFT/ENTER (white)	5322 414 60146	
Window	5322 450 60633	6.2
Sam front (PM2534)	5322 447 70087	
Sam front (PM2535)	5322 447 90691	
Input unit	5322 694 54034	6.3
Contact spring (input)	4822 530 80158	
Fuseholder	5322 256 34079	6.3 and 8.1
Slide switch (guard)	5322 277 21046	6.3
Reed contact	5322 280 24126	8.1
Flat cable	5322 321 21307	8.1
Jumper	5322 263 60062	8.1
Foot (rear)	5322 462 10258	8.2
Footplug (rear)	5322 462 40109	8.2
Foot (bottom)	5322 462 10259	8.2
Footplug (bottom)	5322 462 44148	8.2
Lever (left)	5322 405 90307	8.2
Lever (right)	5322 405 90308	8.2
Handle	5322 498 50193	8.2
PCB guide	5322 290 60588	
Plastic connecting rail	5322 460 60398	4.1
Coverplate (input unit)	5322 460 60397	6.4
Coverplate (options)	5322 460 60399	6.4
Measuring pin black	5322 264 20045	
Measuring pin red	5322 264 20046	
Lead black	5322 321 20572	
Lead red	5322 321 20573	
Adapter red	5322 264 20051	
Adapter black	5322 264 20052	
Mains cable	5322 321 10388	
Fuse F 5x20 3,15 A	4822 253 20025	
Fuse T 5x20 63 mA	4822 253 30004	
Fuse T 5x20 125 mA	4822 253 30007	
Fuse T 5x20 200 mA	4822 253 30012	

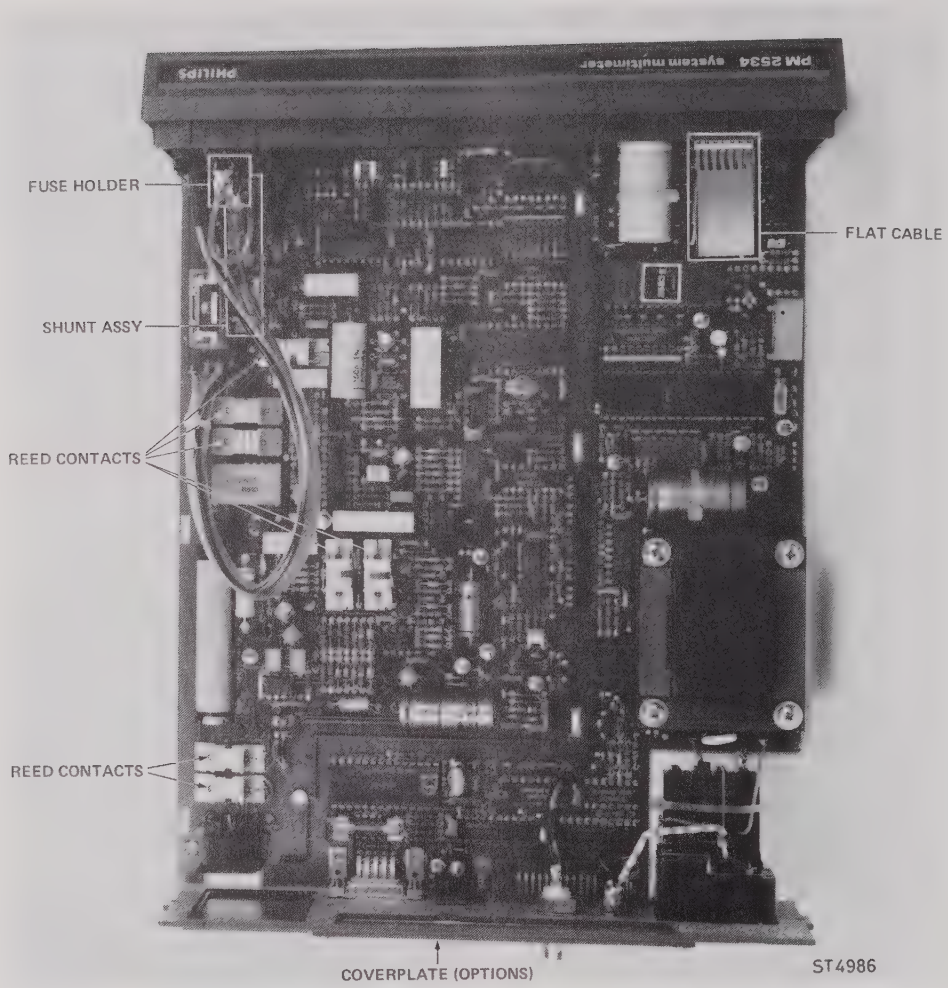


Figure 8.1

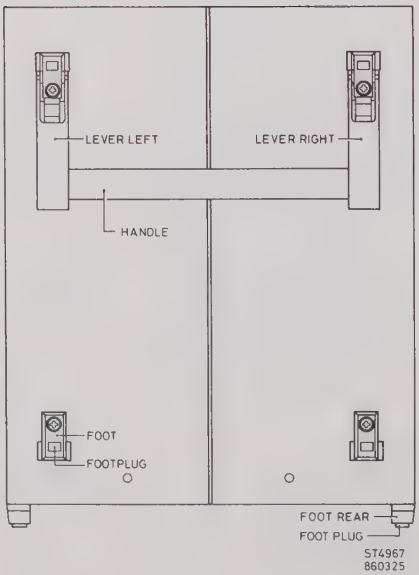


Figure 8.2

8.2 ELECTRICAL PARTS

8.2.1 Capacitors

posno.	description	ordering no.
C 1101	2% 100PF	5322 122 32655
C 1102	63V 10% 390NF	5322 121 42502
C 1103	63V 10% 390NF	5322 121 42502
C 1104	2% 18PF	4822 122 31061
C 1105	-20+80% 22NF	4822 122 30103
C 1106	-20+80% 22NF	4822 122 30103
C 1107	100V 10% 1UF	5322 121 40197
C 1201	630V 1% 1NF	4822 121 50591
C 1202	-20+80% 22NF	4822 122 30103
C 1203	-20+80% 22NF	4822 122 30103
C 1204	2% 33PF	5322 122 32072
C 1303	400V 10% 68NF	4822 121 42078
C 1304	2% 12PF	4822 122 31196
C 1305	2% 12PF	4822 122 31196
C 1306	0.25PF 0.68PF	4822 122 31215
C 1307	63V 1% 2150PF	5322 121 50985
C 1308	2% 330PF	5322 122 32704
C 1310	2% 100PF	4822 122 31316
C 1311	10V 20% 15UF	5322 124 14036
C 1312	-20+80% 22NF	4822 122 30103
C 1313	-20+80% 22NF	4822 122 30103
C 1314	63V 10% 150NF	4822 121 41854
C 1315	100V 10% 1.5UF	5322 121 40227
C 1316	63V 10% 100NF	5322 121 42386
C 1317	100V 10% 1UF	5322 121 40197
C 1401	-20+80% 22NF	4822 122 30103
C 1402	-20+80% 22NF	4822 122 30103
C 1403	-20+80% 22NF	4822 122 30103
C 1404	-20+80% 22NF	4822 122 30103
C 1405	-20+80% 22NF	4822 122 30103
C 1406	-20+80% 22NF	4822 122 30103
C 1407	63V 1% 160NF	5322 121 54116
C 1408	63V 10% 220NF	5322 122 32255
C 1409	100V 10% 3.3UF	5322 121 40283
C 1410	-20+80% 22NF	4822 122 30103
C 1411	2% 220PF	5322 122 34047
C 1412	-20+80% 22NF	4822 122 30103
C 1413	-20+80% 22NF	4822 122 30103
C 1414	-20+80% 22NF	4822 122 30103
C 1415	2% 18PF	4822 122 31061
C 1416	2% 18PF	4822 122 31061
C 1417	-20+80% 22NF	4822 122 30103
C 1418	-20+80% 22NF	4822 122 30103
C 1433	50V 10% 22NF	5322 122 10356
C 1434	50V 10% 22NF	5322 122 10356
C 1451	50V 10% 22NF	5322 122 10356
C 1452	50V 10% 22NF	5322 122 10356
C 1454	50V 10% 22NF	5322 122 10356
C 1455	630V 1% 51.1PF	5322 121 50984
C 1456	2% 18PF	4822 122 31061
C 1457	2% 100PF	4822 122 31316
C 1458	50V 10% 22NF	5322 122 10356
C 1501	-20+80% 22NF	4822 122 30103
C 1502	-20+80% 22NF	4822 122 30103
C 1503	-20+20% 10UF	5322 124 21731
C 1504	-20+80% 22NF	4822 122 30103
C 1505	-20+80% 22NF	4822 122 30103
C 1506	50V 10% 22NF	5322 122 10356
C 1507	-20+80% 22NF	4822 122 30103
C 1508	-20+80% 22NF	4822 122 30103

posno.	description		ordering no.
C 1509	-20+80%	22NF	4822 122 30103
C 1510	-20+80%	22NF	4822 122 30103
C 1511	-20+80%	22NF	4822 122 30103
C 1512	-20+80%	22NF	4822 122 30103
C 1513	-20+80%	22NF	4822 122 30103
C 1514	-20+80%	22NF	4822 122 30103
C 1515	-20+80%	22NF	4822 122 30103
C 1516	-20+80%	22NF	4822 122 30103
C 1531	-20+80%	22NF	4822 122 30103
C 1601	-20+20%	4700UF	5322 124 21504
C 1602	-20+20%	1UF	5322 124 41098
C 1603	-20+20%	10UF	5322 124 21731
C 1611	-20+20%	1UF	5322 124 41098
C 1612	-20+80%	22NF	4822 122 30103
C 1613	-20+20%	1UF	5322 124 41098
C 1614	-20+80%	22NF	4822 122 30103
C 1615	-10+50%	330UF	4822 124 20694
C 1616	-20+20%	10UF	5322 124 21731
C 1617	-20+80%	22NF	4822 122 30103
C 1618	-20+80%	22NF	4822 122 30103
C 1619	-20+20%	1UF	5322 124 41098
C 1620	-20+80%	22NF	4822 122 30103
C 1621	-20+20%	1500UF	4822 124 21505
C 1701	-20+20%	10UF	5322 124 21731
C 1702	2%	33PF	5322 122 32072
C 1703	2%	33PF	5322 122 32072
C 1704	-20+80%	22NF	4822 122 30103
C 1705	-20+80%	22NF	4822 122 30103
C 1706	-20+20%	10UF	5322 124 21731
C 1708	-20+80%	22NF	4822 122 30103
C 1801	-20+50%	10NF	4822 122 31414
C 1802	-20+80%	22NF	4822 122 30103
C 1803	-20+80%	22NF	4822 122 30103
C 1804	-20+80%	22NF	4822 122 30103
C 1805	-20+80%	22NF	4822 122 30103
C 1806	-20+80%	22NF	4822 122 30103
C 1807	-20+20%	10UF	5322 124 21731
C 1808	-20+20%	1UF	5322 124 41098
C 1809	-20+20%	10UF	5322 124 21731
C 1810	-20+80%	22NF	4822 122 30103
C 1901	-20+80%	22NF	4822 122 30103
C 1902	2%	33PF	5322 122 32072
C 1903	2%	33PF	5322 122 32072
C 1904	-20+80%	22NF	4822 122 30103
C 1905	-20+20%	10UF	5322 124 21731
C 1906	-20+80%	22NF	4822 122 30103
C 1907	-20+80%	22NF	4822 122 30103
C 1908	-20+80%	22NF	4822 122 30103
C 2101	-20+80%	22NF	4822 122 30103
C 2102	-20+80%	22NF	4822 122 30103

8.2.2 Resistors

posno.	description	ordering no.	
R 1101		5322 111 94044	
R 1102	MR25 1% 100E	5322 116 55549	
R 1103	VR68 5% 100K	5322 116 51722	
R 1104	MR25 1% 6K19	5322 116 55426	
R 1105	MR25 1% 10K	4822 116 51253	
R 1106	MR25 1% 6K19	5322 116 55426	
R 1107	MR25 1% 261E	5322 116 54502	
R 1108	0.1% 1K33	5322 116 53206	
R 1109	0.1% 147E	5322 116 53199	
R 1110	MR25 1% 133K	5322 116 54708	
R 1111	MR25 1% 14K7	5322 116 54632	
R 1112	MR25 1% 10K	4822 116 51253	
R 1113	MR25 1% 1K	4822 116 51235	
R 1114	MR25 1% 22K6	5322 116 50481	
R 1115	MR25 1% 100K	4822 116 51268	
R 1116	MR25 1% 1K	4822 116 51235	
R 1151	MR25 1% 19E6	5322 116 50473	
R 1152	2.2A 15E	5322 116 34035	
R 1153	Shunt assy	5322 209 50548	see figure 4.3 and 8.1
R 1154	MR25 1% 100K	4822 116 51268	
R 1201	245V 750E-1K5	5322 116 44006	
R 1202	245V 750E-1K5	5322 116 44006	
R 1203	0.25% 2K52	5322 116 53195	
R 1204	MR25 1% 4K42	5322 116 50556	
R 1205	0.25% 357K	5322 116 53196	
R 1206	MR25 1% 10K	4822 116 51253	
R 1207	0.25% 845K	5322 116 53204	
R 1208	0.25% 14K	5322 116 53194	
R 1209	MR25 1% 10K	4822 116 51253	
R 1210	0.25% 249K	5322 116 53205	
R 1211	0.25% 249K	5322 116 53205	
R 1213	MR25 1% 100K	4822 116 51268	
R 1301	MR25 1% 10K	4822 116 51253	
R 1302	MR25 1% 681K	5322 116 55284	
R 1303	MR30 1% 511K	5322 116 55636	
R 1304	MR30 1% 511K	5322 116 55636	
R 1305	MR25 1% 681K	5322 116 55284	
R 1306	MR25 1% 2K55	5322 116 54577	
R 1307	MR25 1% 162K	5322 116 54716	
R 1308	MR25 1% 2K05	5322 116 50664	
R 1309	MR25 1% 20K5	5322 116 55419	
R 1310	MR25 1% 16K9	5322 116 54635	
R 1311	MR25 1% 48K7	5322 116 50442	
R 1401	MR25 1% 10K	4822 116 51253	
R 1402	MR25 1% 10K	4822 116 51253	
R 1403	MR25 1% 1K	4822 116 51235	
R 1404	MR25 1% 10K	4822 116 51253	
R 1405	MR25 1% 14K7	5322 116 54632	
R 1406	MR25 1% 10K	4822 116 51253	
R 1407	MR25 1% 8K25	5322 116 51498	
R 1411	MR25 1% 64K9	5322 116 50514	
R 1412	MR25 1% 3K48	5322 116 55367	
R 1413	MR25 1% 10K	4822 116 51253	
R 1414	MR25 1% 10K	4822 116 51253	
R 1415	MR25 1% 10K	4822 116 51253	
R 1416	MR25 1% 10K	4822 116 51253	
R 1417	MR25 1% 1K21	5322 116 54557	
R 1418	MR25 1% 1E47	5322 116 55604	
R 1419	MR25 1% 5K9	5322 116 50583	
R 1420	MR25 1% 1K	4822 116 51235	
R 1421	MR25 1% 10K	4822 116 51253	
R 1422	MR25 1% 121K	5322 116 54704	
R 1423	MR25 1% 1K	4822 116 51235	

posno.	description	ordering no.
R 1425	MR25 1% 11E	5322 116 54059
R 1426	MR25 1% 2K15	5322 116 50767
R 1431	MR25 1% 5K62	4822 116 51281
R 1432	MR25 1% 4K02	5322 116 55448
R 1433	MR25 1% 4K42	5322 116 50556
R 1434	MR25 1% 10K	4822 116 51253
R 1435	MR25 1% 10K	4822 116 51253
R 1436	MR25 1% 10K	4822 116 51253
R 1437	MR25 1% 10K	4822 116 51253
R 1438	MR25 1% 10K	4822 116 51253
R 1439	MR25 1% 10K	4822 116 51253
R 1440	MR25 1% 10K	4822 116 51253
R 1441	-101-333 33K	5322 111 90881
R 1451	MR25 1% 1K	4822 116 51235
R 1452	0.1% 3K09	5322 116 53201
R 1453	0.25% 1K54	5322 116 53192
R 1454	0.25% 768E	5322 116 53193
R 1455	MR25 1% 383E	5322 116 55368
R 1456	0.1% 10K	5322 116 53198
R 1457	0.1% 1K58	5322 116 53197
R 1458	0.25% 187E	5322 116 53191
R 1459	MR25 1% 95E3	5322 116 50569
R 1460	MR25 1% 46E4	5322 116 50492
R 1461	MR25 1% 46E4	5322 116 50492
R 1462	MR25 1% 1K54	5322 116 50586
R 1463	0.1% 10K	5322 116 53198
R 1464	0.1% 10K	5322 116 53198
R 1470	MR25 1% 1M	5322 116 55535
R 1501	MR25 1% 100E	5322 116 55549
R 1502	MR25 1% 100E	5322 116 55549
R 1503	MR25 1% 100E	5322 116 55549
R 1504	MR25 1% 100E	5322 116 55549
R 1505	MR25 1% 287E	5322 116 54506
R 1506	MR25 1% 100E	5322 116 55549
R 1507	MR25 1% 100E	5322 116 55549
R 1508	MR25 1% 100E	5322 116 55549
R 1509	MR25 1% 100E	5322 116 55549
R 1510	MR25 1% 100E	5322 116 55549
R 1511	MR25 1% 100E	5322 116 55549
R 1512	MR25 1% 5K9	5322 116 50583
R 1513	MR25 1% 5K9	5322 116 50583
R 1514	MR25 1% 5K11	5322 116 54595
R 1515	MR25 1% 11K	5322 116 54623
R 1516	MR25 1% 11K	5322 116 54623
R 1517	MR25 1% 715E	5322 116 50571
R 1518	MR25 1% 287E	5322 116 54506
R 1519	MR25 1% 10K	4822 116 51253
R 1520	MR25 1% 287E	5322 116 54506
R 1521	MR25 1% 10K	4822 116 51253
R 1522	MR25 1% 100E	5322 116 55549
R 1523	MR25 1% 100E	5322 116 55549
R 1531	MR25 1% 13K3	5322 116 55276
R 1532	MR25 1% 10K	4822 116 51253
R 1533	MR25 1% 10K	4822 116 51253
R 1534	MR25 1% 1K	4822 116 51235
R 1535	MR25 1% 22K6	5322 116 50481
R 1601	MR25 1% 619E	4822 116 51232
R 1602	MR25 1% 2K26	5322 116 50675
R 1603	351V 429V 10%	5322 116 21072

posno.	description	ordering no.
R 1701	MR25 1% 1K	4822 116 51235
R 1702	-105-103 10K	5322 111 90473
R 1703	MR25 1% 100E	5322 116 55549
R 1704	MR25 1% 100E	5322 116 55549
R 1705	MR25 1% 10K	4822 116 51253
R 1706	MR25 1% 10K	4822 116 51253
R 1707	MR25 1% 10K	4822 116 51253
R 1708	MR25 1% 10K	4822 116 51253
R 1709	MR25 1% 100K	4822 116 51268
R 1713	MR25 1% 1K	4822 116 51235
R 1802	MR25 1% 4K64	5322 116 50484
R 1803	MR25 1% 100K	4822 116 51268
R 1804	MR25 1% 100K	4822 116 51268
R 1805	MR25 1% 18K7	5322 116 55362
R 1806	MR25 1% 2K05	5322 116 50664
R 1807	MR25 1% 301K	5322 116 54743
R 1808	MR25 1% 226E	5322 116 54497
R 1809	MR25 1% 226E	5322 116 54497
R 1810	MR25 1% 8K25	5322 116 51498
R 1811	MR25 1% 11K	5322 116 54623
R 1812	MR25 1% 11K	5322 116 54623
R 1813	MR25 1% 100E	5322 116 55549
R 1814	MR25 1% 100E	5322 116 55549
R 1815	MR25 1% 10K	4822 116 51253
R 1816	MR25 1% 2K74	5322 116 50636
R 1817	MR25 1% 1K	4822 116 51235
R 1818	MR25 1% 100K	4822 116 51268
R 1819	MR25 1% 30K1	5322 116 54655
R 1820	MR25 1% 4K64	5322 116 50484
R 1821	MR25 1% 1M	5322 116 55535
R 1822	MR25 1% 10K	4822 116 51253
R 1823	MR25 1% 10K	4822 116 51253
R 1901	MR25 1% 100E	5322 116 55549
R 1902	MR25 1% 100E	5322 116 55549
R 1903	MR25 1% 10K	4822 116 51253
R 1904	MR25 1% 10K	4822 116 51253
R 1905	MR25 1% 1M	5322 116 55535
R 1906	MR25 1% 100E	5322 116 55549
R 1907	MR25 1% 100E	5322 116 55549
R 1908	MR25 1% 2K74	5322 116 50636
R 1909	MR25 1% 4K64	5322 116 50484
R 1910	MR25 1% 100E	5322 116 55549
R 1911	MR25 1% 121E	5322 116 54426
R 2101	MR25 1% 196K	5322 116 55364
R 2102	MR25 1% 3K48	5322 116 55367
R 2103	MR25 1% 3K32	4822 116 51247
R 2104	MR25 1% 590E	5322 116 50561
R 2105	CTP10 20% 220E	4822 100 10019
R 2201	MR25 1% 10K	4822 116 51253

8.2.3 Semiconductors

posno.	description		ordering no.
V 1103	BAS45	PEL	5322 130 32256
V 1104	BAW62	PEL	4822 130 30613
V 1105	BAW62	PEL	4822 130 30613
V 1106	BZX79-C4V3	PEL	4822 130 31554
V 1107	BZX79-C4V3	PEL	4822 130 31554
V 1108	BZV85-C5V6		4822 130 32904
V 1109	BZV85-C5V6		4822 130 32904
V 1110	BF256A	PEL	5322 130 44418
V 1111	BC559B	PEL	4822 130 44358
V 1112	BAW62	PEL	4822 130 30613
V 1151	BC337	PEL	4822 130 40855
V 1152	BC337	PEL	4822 130 40855
V 1153	BT139-600	PEL	5322 130 24079
V 1154	BFW13	PEL	5322 130 40516
V 1201	BF256B	PEL	5322 130 44744
V 1202	BFW13	PEL	5322 130 40516
V 1203	BC337	PEL	4822 130 40855
V 1204	BC337	PEL	4822 130 40855
V 1205	BC337	PEL	4822 130 40855
V 1206	BC549C	PEL	4822 130 44246
V 1207	BC549C	PEL	4822 130 44246
V 1208	BAW62	PEL	4822 130 30613
V 1209	BAW62	PEL	4822 130 30613
V 1210	BAW62	PEL	4822 130 30613
V 1301	BSV80	PEL	5322 130 34044
V 1303	BF256B	PEL	5322 130 44744
V 1304	BSV80	PEL	5322 130 34044
V 1401	BAS45	PEL	5322 130 32256
V 1402	BAS45	PEL	5322 130 32256
V 1403	BF256B	PEL	5322 130 44744
V 1404	BAW62	PEL	4822 130 30613
V 1405	ON528	PEL	5322 130 44405
V 1406	BAW62	PEL	4822 130 30613
V 1407	BF256B	PEL	5322 130 44744
V 1408	BAW62	PEL	4822 130 30613
V 1409	BAW62	PEL	4822 130 30613
V 1451	BAW62	PEL	4822 130 30613
V 1452	BZV14	PEL	5322 130 34568
V 1453	BAW62	PEL	4822 130 30613
V 1501	BC547B	PEL	4822 130 40959
V 1502	BC547B	PEL	4822 130 40959
V 1503	BAX12 DO-35	PEL	5322 130 34605
V 1504	BAX12 DO-35	PEL	5322 130 34605
V 1505	BAX12 DO-35	PEL	5322 130 34605
V 1506	BAX12 DO-35	PEL	5322 130 34605
V 1507	BAX12 DO-35	PEL	5322 130 34605
V 1508	BAX12 DO-35	PEL	5322 130 34605
V 1509	BAX12 DO-35	PEL	5322 130 34605
V 1510	BAX12 DO-35	PEL	5322 130 34605
V 1531	BAW62	PEL	4822 130 30613
V 1532	BAW62	PEL	4822 130 30613
V 1601	BYW54	PEL	5322 130 34919
V 1602	BYW54	PEL	5322 130 34919
V 1611	BAX18	PEL	4822 130 34121
V 1612	BAX18	PEL	4822 130 34121
V 1613	BAX18	PEL	4822 130 34121
V 1614	BAX18	PEL	4822 130 34121
V 1615	BAX18	PEL	4822 130 34121
V 1616	BZX79-C3V3	PEL	5322 130 31504
V 1617	BAX18	PEL	4822 130 34121
V 1618	BZV46-C1V5	PEL	5322 130 34865
V 1619	BAX18	PEL	4822 130 34121

posno.	description		ordering no.
V 1620	BAX18	PEL	4822 130 34121
V 1621	BAX18	PEL	4822 130 34121
V 1622	BZX79-C3V9		4822 130 31981
V 1701	BAW62	PEL	4822 130 30613
V 1702	BAW62	PEL	4822 130 30613
V 1703	BZX79-C3V9	PEL	4822 130 31981
V 1706	BC547B	PEL	4822 130 40959
V 1707	BAW62	PEL	4822 130 30613
V 1801	BC559B	PEL	4822 130 44358
V 1802	BAW62	PEL	4822 130 30613
V 1803	BC547B	PEL	4822 130 40959
V 2101	BZV46-C1V5	PEL	5322 130 34865
V 2102	BC547B	PEL	4822 130 40959

8.2.4 Integrated circuits

posno.	description		ordering no.	
D 1301	OQ0068A		5322 209 81884	
D 1401	DEVICE SPEC.		5322 209 11127	
D 1402	HEF4051BD	PEL	4822 209 10262	
D 1403	HEF4066BD	PEL	5322 209 10357	
D 1501	OQ 0300A		5322 209 11126	
D 1511	PCF8574P	PEL	5322 209 10883	
D 1512	PCF8574P	PEL	5322 209 10883	
D 1513	SAA1300	PEL	4822 209 81338	
D 1531	HEF4013BD	PEL	4822 209 10248	
D 1701	P8031AH	INT	5322 209 11128	
D 1702	SN74LS373	T.I	5322 209 86062	
D 1703	EPROM	16K	5322 209 50551	(PM2534)
D 1703	EPROM	32K	5322 209 50712	(PM2535)
D 1705	CDM6116-AE-2		5322 209 83103	(PM2534)
D 1705	CDM6264		5322 209 50644	(PM2535)
D 1801	OQ 0300A		5322 209 11126	
D 1802	HEF4528BD	PEL	4822 209 10277	
D 1901	SA1045		5322 209 83269	
D 1902	MAF8441P/T008		5322 209 11131	
D 1903	SN74LS02N	T.I	5322 209 85312	
D 1904	SN74LS05N	T.I	5322 209 84994	
D 1905	SN75160AN	T.I	5322 209 81807	
D 1906	SN75161AN	T.I	5322 209 81842	
D 2101	PCF8576T	PEL	5322 209 11129	
D 2201	PCF8574P	PEL	5322 209 10883	
N 1101	LTC1052CN8	L.T	5322 209 83378	
N 1201	UA308ATC	FSC	5322 209 83377	
N 1401	LF356N	N.S	5322 209 86422	
N 1402	NE5532P	T.I	5322 209 81919	
N 1403	LM311N	N.S	5322 209 85503	
N 1404	DAC-08EP	PMI	5322 209 83154	
N 1405	UA308ATC	FSC	5322 209 83377	
N 1406	UA308ATC	FSC	5322 209 83377	
N 1531	LM358N	N.S	4822 209 81472	
N 1601	UA7805UC	FSC	5322 209 84841	
N 1611	LM78L05ACZ	N.S	5322 209 80903	
N 1612	LM78L05ACZ	N.S	5322 209 80903	
N 1613	LM337T	N.S	5322 209 81236	
N 1614	LM79L05ACZ	N.S	5322 209 86434	
N 1801	TL7705ACP	T.I	4822 209 82386	
H 1801	CNX36	PEL	5322 130 90097	
H 1802	CNX36	PEL	5322 130 90097	
H 1803	CNX36	PEL	5322 130 90097	
H 1804	CNX36	PEL	5322 130 90097	
H 1805	CNX36	PEL	5322 130 90097	
H 1807	PS20-01-0		5322 280 10148	
	TESTROM		5322 694 54039	

8.2.5 Miscellaneous

posno.	description	ordering no.
G 1601	3 V 1,2 17X33	5322 138 10095
G 1701	UNIT 12000 KHZ	5322 242 71226
G 1901	6000,000KHZ	4822 242 70392
K 0001	1MC 500VDC	5322 280 20162
K 0002	9V	5322 281 60162
K 1101		5322 280 20163
K 1102	5 V.	5322 280 20122
K 1151	6VDC DIPS	5322 280 20159
K 1201	5 V.	5322 280 20122
K 1202	5VDC 1A	5322 280 20161
K 1203	5 V.	5322 280 20122
K 1301	5VDC 1A	5322 280 20161
K 1302	5 V.	5322 280 20122
K 1303	5 V.	5322 280 20122
L 0001	H F CHOKE 3B	5322 158 10052
L 0002	H F CHOKE 3B	5322 158 10052
X 0001	TRIGGER INPUT	4822 267 10062
X 002	MAINS CONNECTOR	5322 265 30406
X 1201	8-P CONNECTOR	5322 267 54107
X 1202	8-P CONNECTOR	5322 267 54107
X 1901	9-P CONNECTOR	5322 267 50594
X 1902	24P IEEE-488 CONNECT.	5322 267 60162
X 1903	10-P CONNECTOR	5322 265 40485
X 2101	7P. CONNECTOR	5322 265 40486

9. CIRCUIT DIAGRAMS AND PRINTED CIRCUIT BOARDS LAY-OUTS

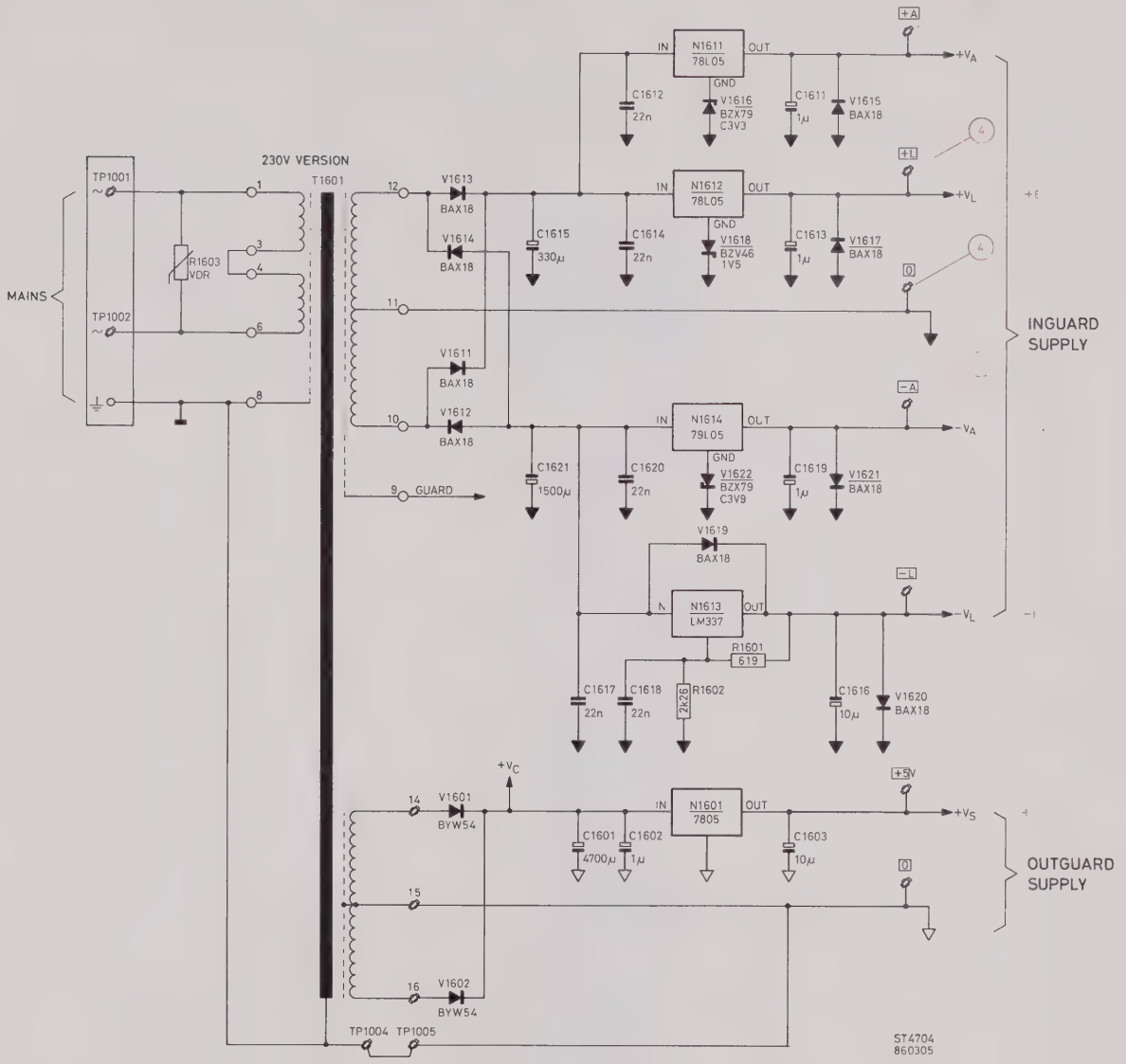
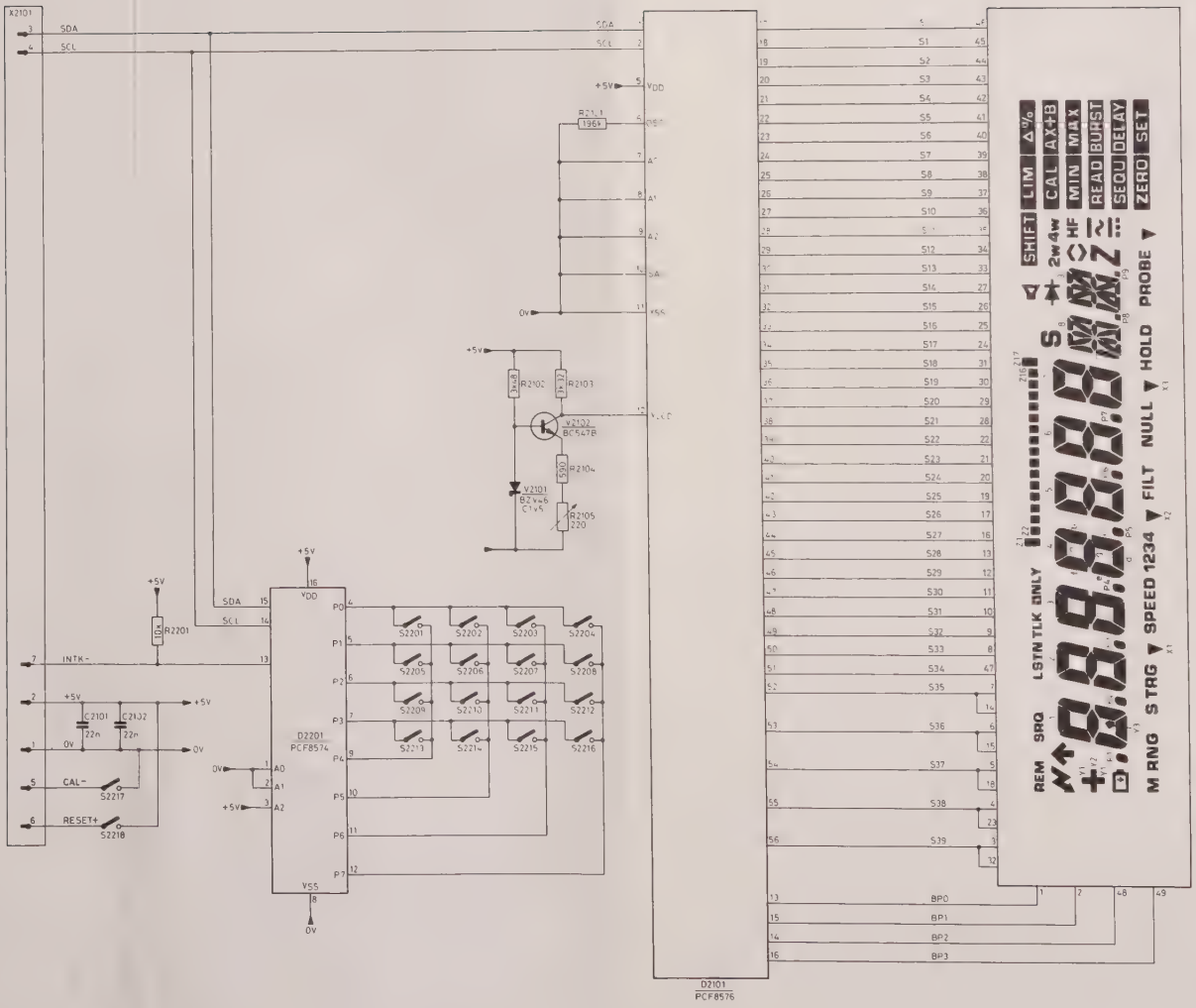


Figure 9.1 Power supply



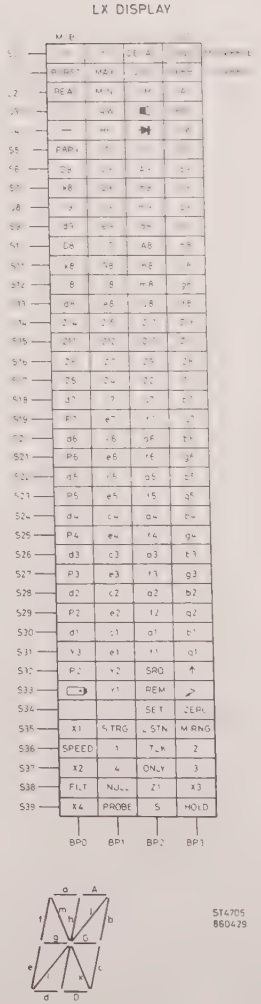


Figure 9.2 Display

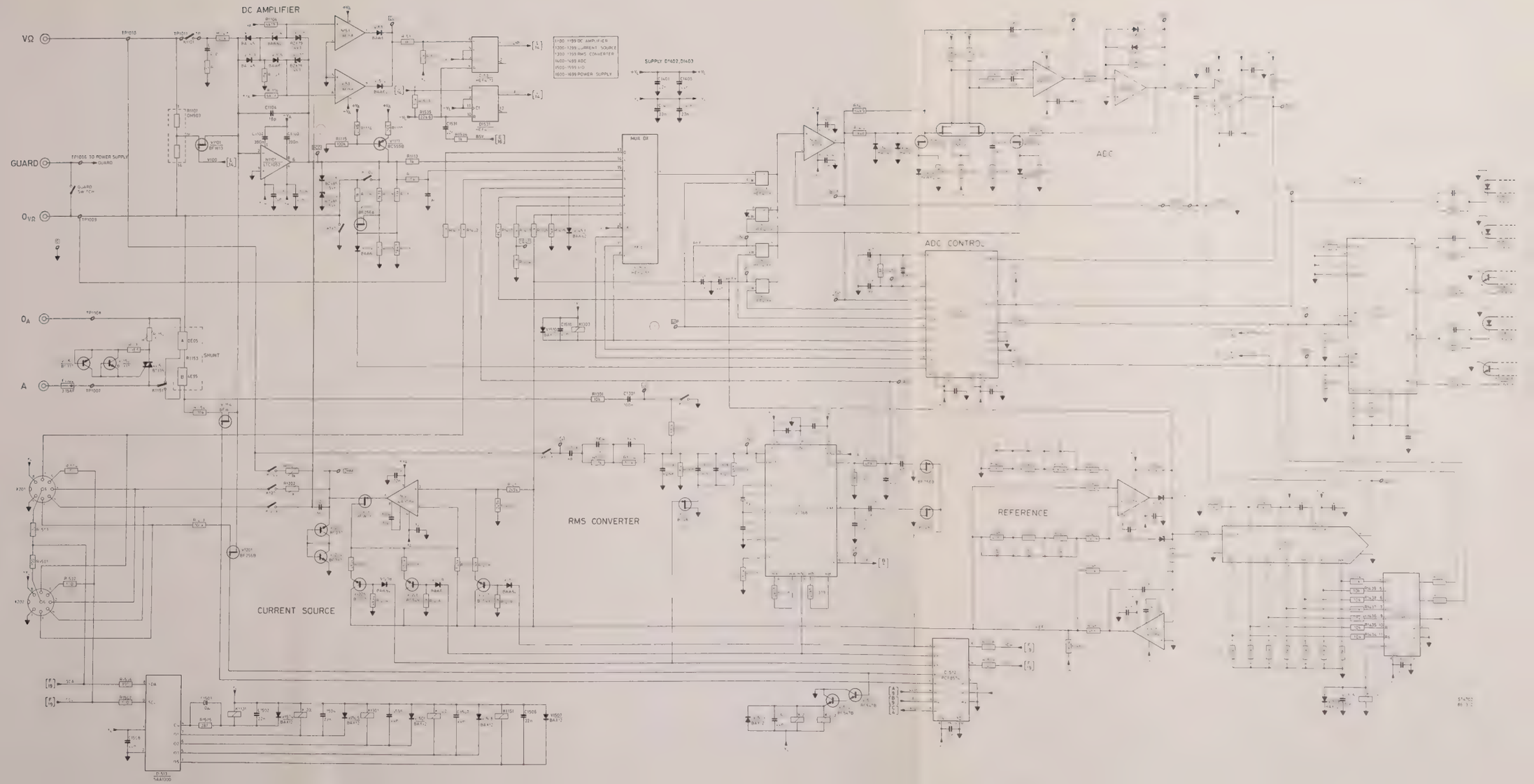


Figure 9.3 Analog

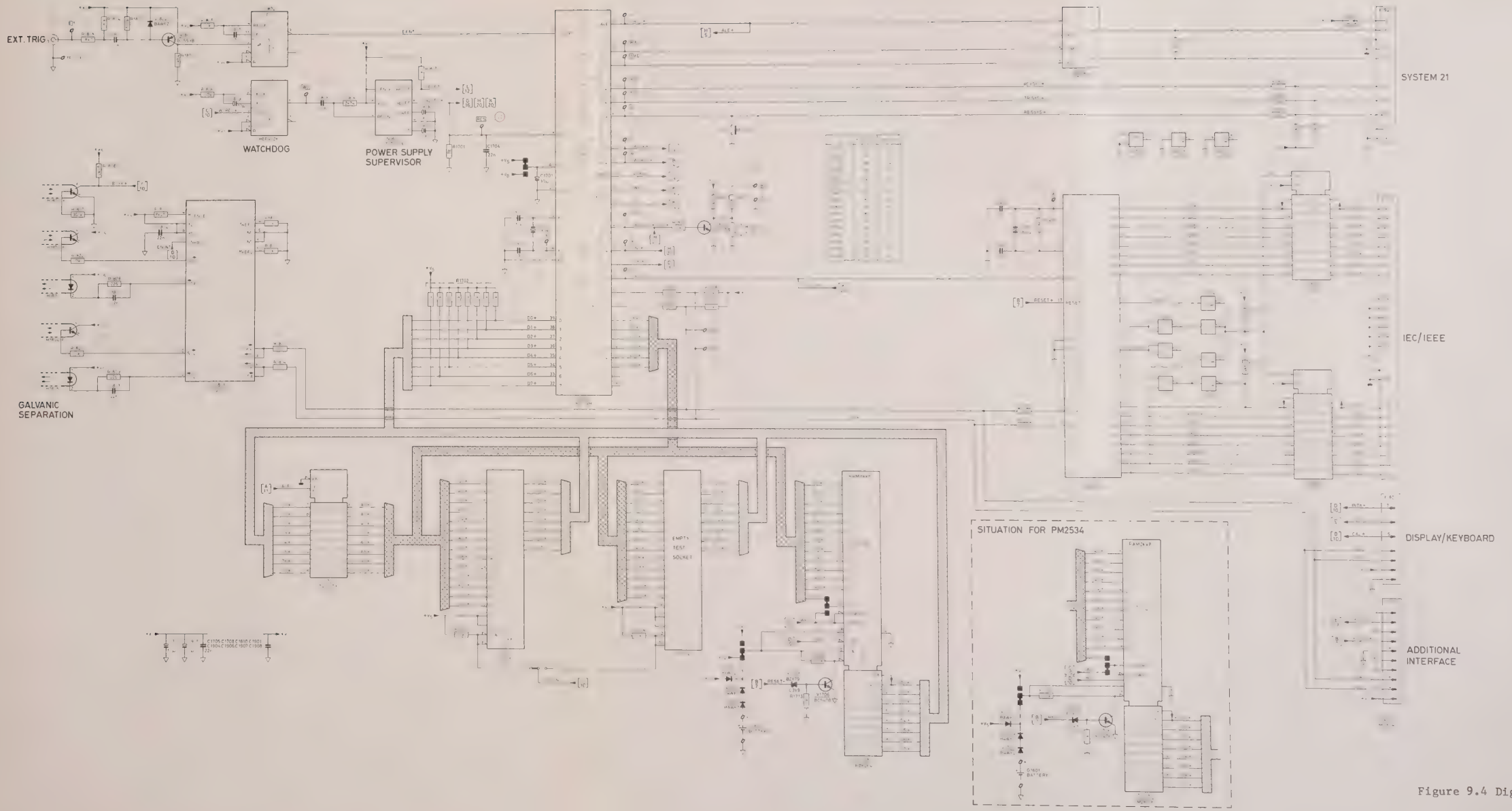


Figure 9.4 Digital

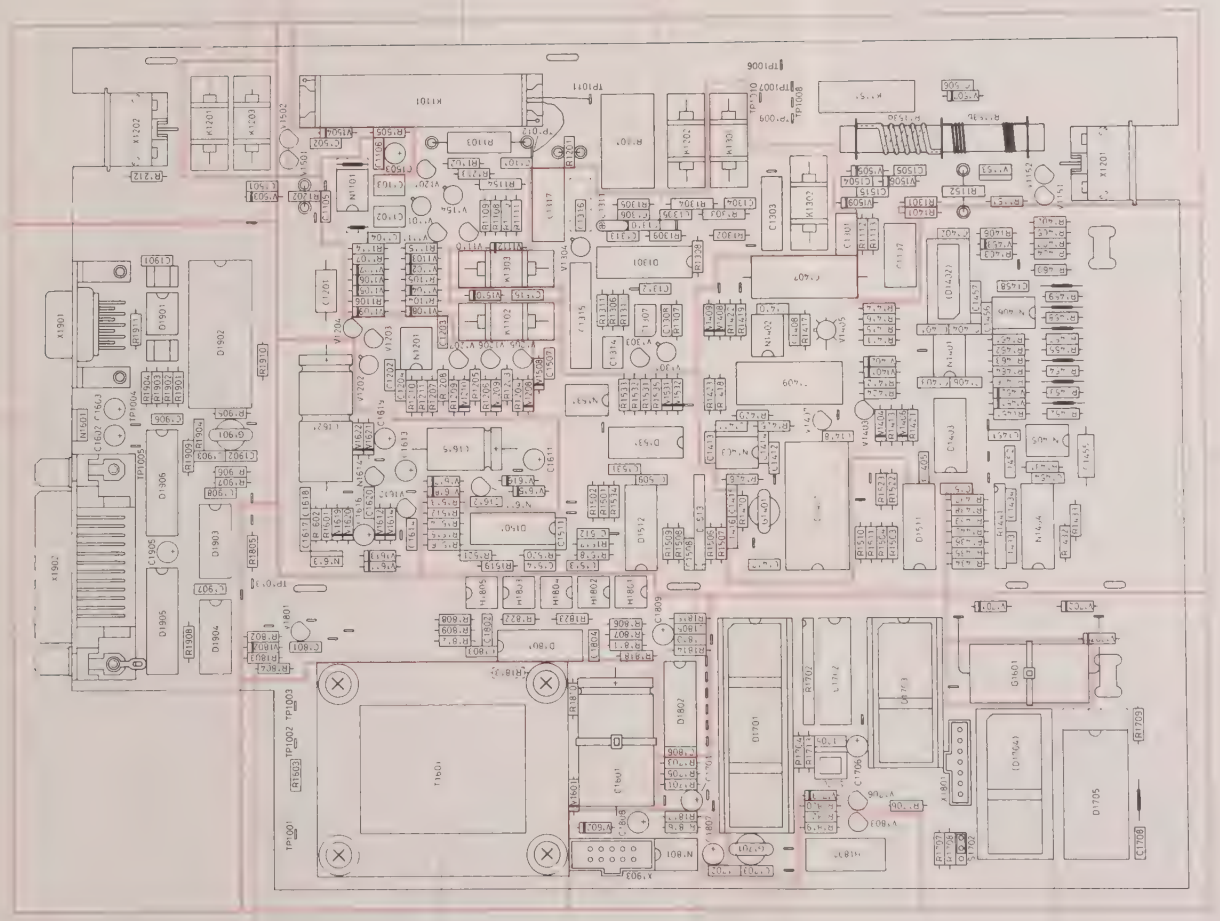


Figure 9.5 Parts location

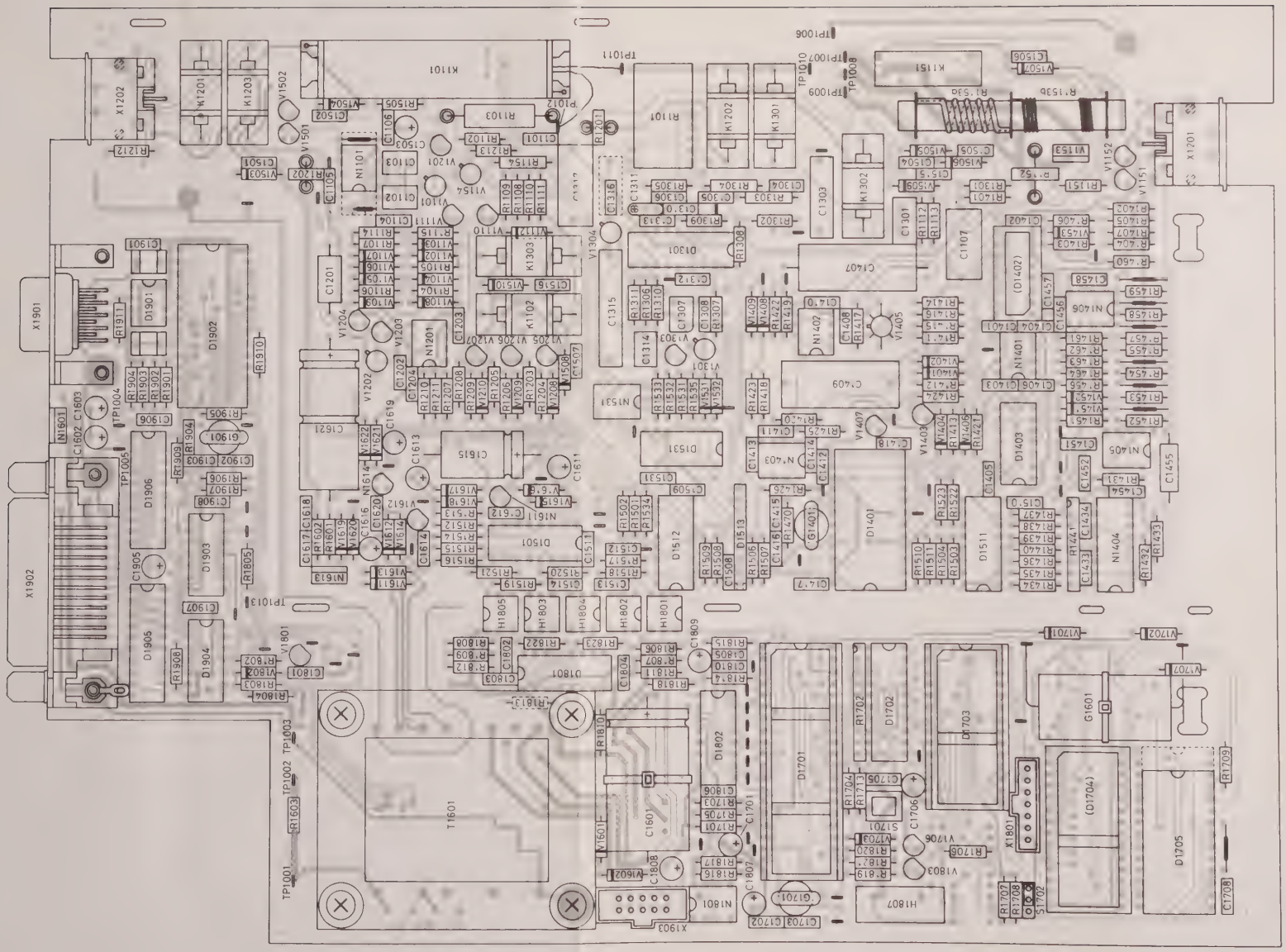


Figure 9.6 Main pcb, component side

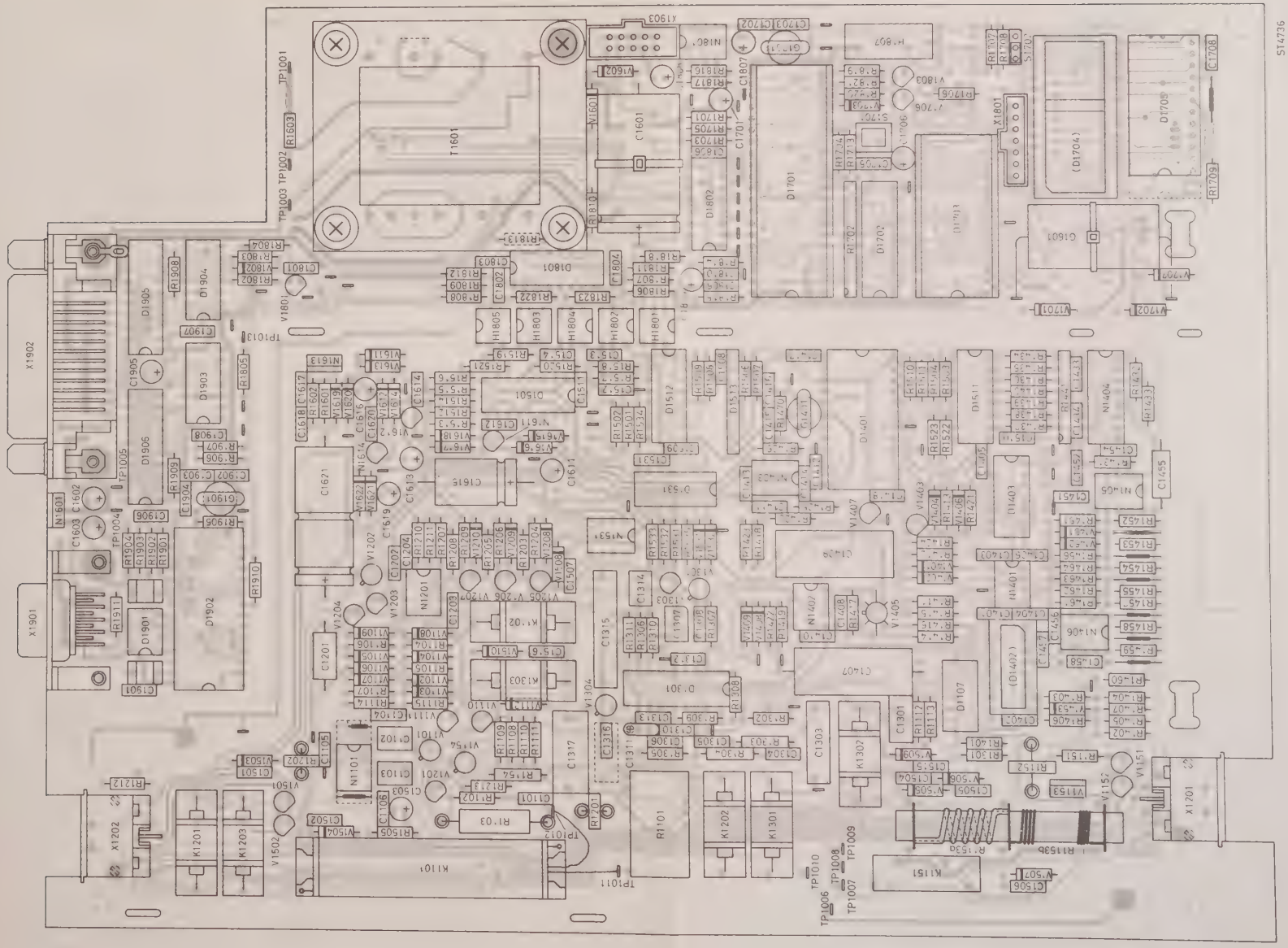


Figure 9.7 Main pcb, conductor side

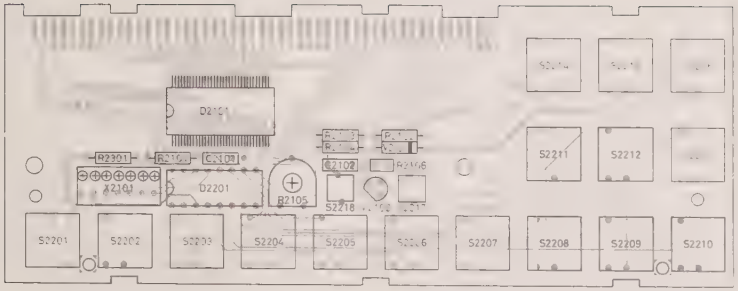


Figure 9.8 Display pcb, component side

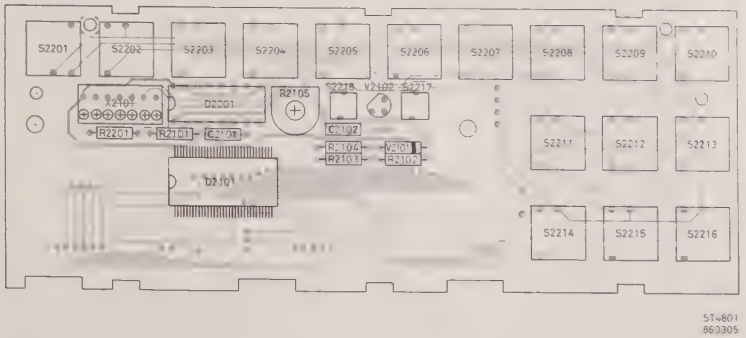


Figure 9.9 Display pcb, conductor side

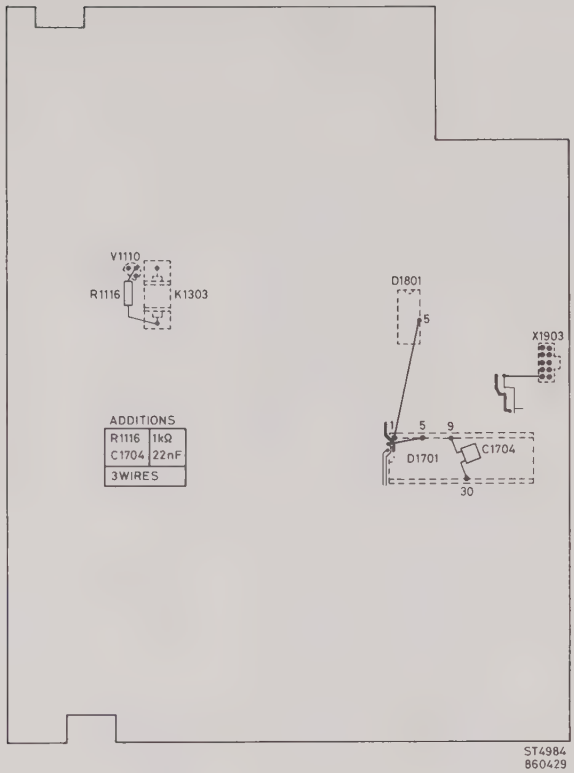


Figure 9.10 Additional components conductor side main pcb (PM2534 version)

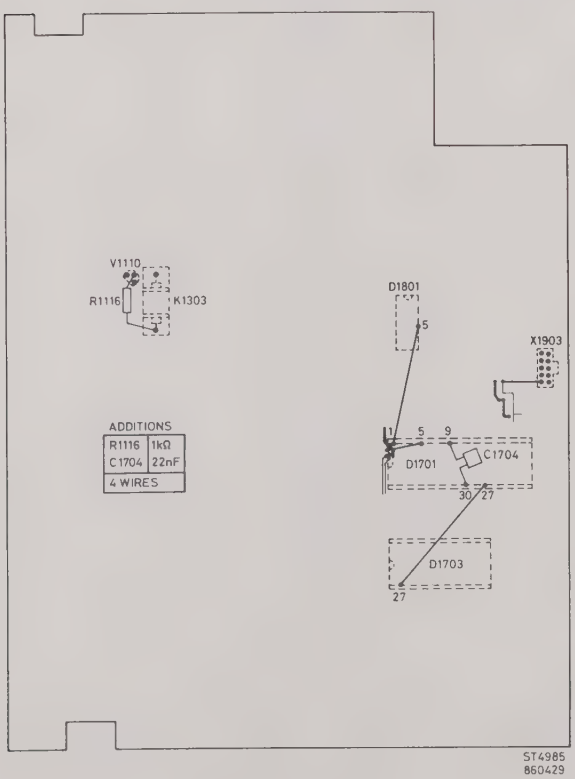


Figure 9.11 Additional components conductor side main pcb (PM2535 version)

10. GLOSSARY OF TERMS

A0-A13	Adress lines
ALE	Adress latch enable
ATACK	Attention acknowledge
ATN	Attention
ATNR	Attention received
BUSY	Busy
CAL	Calibrate
CFI	Crest factor
D0-D7	Data lines
DAV	Data valid
DAVS	Data valid send
ENINI	Enable I^2C transport
ENINT	Enable interrupt
EOI	End or identity
EOIS	End or identity send
EXINT	External interrupt
IECINT	IEC interrupt
IFC	Interface clear
IFCR	Interface clear received
INTK	Interrupt keyboard
NDAC	No data accepted
NRFD	Not ready for data
OL	Overload (on display ↑)
PSEN	Program store enable
RxD	Receive data
RDYSYS	Ready System 21
RD	Read data
REC	Receive
REF+	Positive reference
REF-	Negative reference
REN	Remote enable
RENR	Remote received
RESET	Reset
RESSYS	Reset System 21
RFDS	Ready for data send
SCL	Serial clock
SDA	Serial data
SRQ	Service request
TXD	Transmit data
TA	Talker active
TRISYS	Trigger System 21
WDRES	Watchdog reset
WR	Write

www.manualsplus.com
1004662